Aviation Week and Space Technology

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January 8, 1962

NASA Models Simulate Space Vehicle Landings

Lockheed C-140 JetStar

Israel Aims for Self-Contained Air Industry

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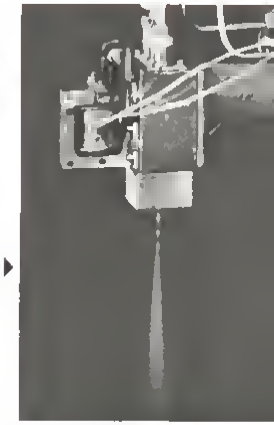
Honeywell

First in Control

Technicians prepare prototype pulse rocket firing during one of continuing series of tests



Firing of integrated design, pulse modulated control rocket at Vickers Research and Development Laboratories

Pulse modulated control rocket fired

Bipropellant, integrated rocket design developed by Vickers for space vehicle control

Successful firing of a pulse modulated bipropellant control rocket at the Research and Development Laboratories of Vickers Incorporated marks a significant upward step in space vehicle control devices. The pulse rocket features a unique integrated design concept to insure reliability, fast response, high efficiency and low power input.

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Get more details by writing for Bulletin A-6005. Vickers Incorporated, Division of Sperry Rand Corporation, Detroit 32, Michigan.

Prototype pulse rocket designed for thrust level of 1 lb. Basic design concept is applicable to any foreseeable control rocket thrust level

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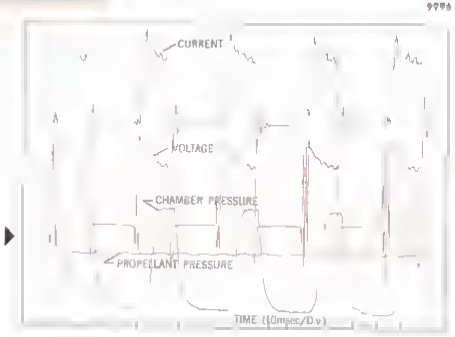

Recording of pulse rocket firing showing typical system response

AEROSPACE CALENDAR

Jan 15-17—Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

Jan 16-18—Eighth Annual National Meeting, American Astronautical Society, Sheraton Park Hotel, Washington, D. C.

Jan. 21-24—Annual Meeting, Helicopter Assn. of America, Marriott Motor Hotel, Dallas, Tex.

Jan. 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 23.

Jan. 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Jan. 24-26—Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

Jan. 29—Army Aviation Contract Services Symposium, Hotel Washington, Washington, D. C. Sponsor: National Aeronautical Services Assn.

Jan. 29-30—Annual Meeting, Assn. of Local Transport Airlines, Washington Hotel, Washington, D. C.

Jan. 29-Feb. 2—American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler and Coliseum, New York, N. Y.

Jan. 30-31—Board of Directors Meeting.

(Continued on page ")

AVIATION WEEK and Space Technology

January 8, 1962

Vol. 76, No. 2

Published weekly with additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), founder. See panel below for directions regarding subscription change of address. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Entered at Albany, N. Y. PUBLICATION OFFICE. PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Executive Vice President; Senior Vice President: John H. Hallman; Vice President and Editorial Director: Joseph H. Allen; Vice President and Director of Advertising Sales: A. R. Venezian; Vice President and Circulation Coordinator: Daniel P. Crowley; Vice President and Controller: HEADQUARTERS OF THE COMPANY: 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, President; Hugh J. Kelly, Executive Vice President; L. Keith Goodwin, Executive Vice President and Treasurer; John J. Lindy, Vice President and Secretary.

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AEROSPACE CALENDAR

(Continued from page 5)

Airport Operators Council International Inn, Tampa, Fla.

Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics. IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid State Circuits Conference. Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 19-21—Tracking & Command of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section Society for Nondestructive Testing, Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory to Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp., Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium. IRE, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences' Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

Mar. 16—Annual Robert H. Goddard Memorial Symposium, "Torques and Attitude Sensing in Satellites," American Astronautical Society, Washington.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf-Astoria, New York.

Mar. 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers, Institute of the Aerospace Sciences, Institute of Radio Engineers, University of Rochester.

Apr. 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles' Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

Apr. 3-6—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 10-12—Second Symposium on The Plasma Sheath—Its Effect Upon Reentry Communication and Detection, New England Mutual Hall, Boston. Sponsor: Al Cambridge Research Laboratories.

Apr. 11-13—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

(Continued on page 9)

AEROSPACE CALENDAR

(Continued from page 7)

Apr. 11-13—Annual Technical Meeting and Equipment Exposition, Institute of Environmental Sciences, Sheraton Towers Hotel, Chicago, Ill.

Apr. 14-16—Second Conference on Kinetics, Equilibria, and Performance of High Temperature Systems, University of California, Los Angeles, Calif. Sponsor: Western States Section/Combustion Institute.

Apr. 16-18—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

Apr. 16-18—Aerospace Systems Reliability Symposium, Institute of the Aerospace Sciences, Salt Lake City, Utah.

Apr. 24-26—Polytechnic Institute of Brooklyn's Symposium on the Mathematical Theory of Automata, United Engineering Center, New York, N. Y.

Apr. 25-29—Western Space Age Industries and Engineering Exposition, Cow Palace, San Francisco, Calif.

Apr. 30-May 2—Meeting on Manned Space Flight, Institute of the Aerospace Sciences, Hotel Chase, St. Louis, Mo.

May 2-4—18th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 2-11—International Space Research and Technology Exhibition, Olympia, London, England. Sponsor: British Interplanetary Society.

May 3-4—First International Congress on Human Factors in Electronics, Institute of Radio Engineers, Lafayette Hotel, Long Beach, Calif.

May 7-9—Materials & Processing for Space Environments Symposium, Society of Aerospace Material and Process Engineers, Hotel Statler, St. Louis, Mo.

May 7-11—Annual Conference, Society of Photographic Scientists and Engineers, Somerset Hotel, Boston, Mass. Cosponsor: Air Force Cambridge Research Laboratories.

May 8-10—12th Annual Electronics Components Conference, Marriott Twin Bridges Motor Hotel, Washington, D. C.

May 14-16—National Aerospace Electronics Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 14-16—Joint Technical Society Department of Defense Symposium on Thermionic Power Conversion, Antlers Hotel, Colorado Springs, Colo.

May 14-17—21st Annual National Conference, Society of Aeronautical Weight Engineers, Benjamin Franklin Hotel, Seattle, Wash.

May 22-24—Conference on Self-Organizing Systems, Museum of Science and Industry, Chicago, Ill. Sponsors: Office of Naval Research, Armour Research Foundation.

May 22-24—National Microwave Theory & Techniques Symposium, Institute of Radio Engineers, Boulder, Colo.

May 23-25—National Telemetering Conference, Sheraton Park Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers, Institute of the Aerospace Sciences, American Rocket Society, American Institute of Electrical Engineers; Instrument Society of America.

May 24-26—Seventh Region Conference on Space Communications, Institute of Radio Engineers, Seattle, Wash.

June 6-7—Symposium on Standards for Filament Wound Reinforced Plastics, Naval Ordnance Laboratory, Silver Spring, Md. Sponsors: U. S. Navy, American Society for Testing and Materials.

June 8-9—13th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

June 13-15—Annual Meeting, Heat Transfer and Fluid Mechanics Institute, University of Washington, Seattle, Wash.

June 19-22—Summer Meeting, Institute of the Aerospace Sciences, Ambassador Hotel, Los Angeles, Calif.

June 25-27—Sixth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

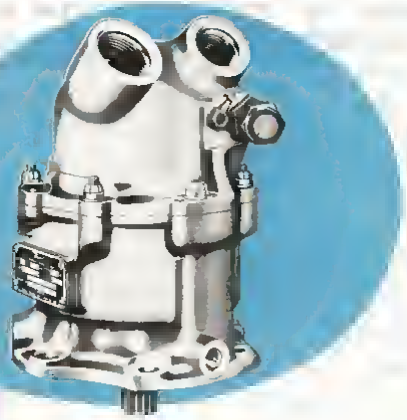
June 25-30—Symposium on Electromagnetic Theory & Antennas, Copenhagen, Denmark. Sponsors: Technical University of Denmark, International Scientific Radio Union.

June 27-28—Ninth Annual Symposium on Computers and Data Processing by the University of Denver's Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

June 27-29—Joint Automatic Control Conference, Institute of Radio Engineers, New York University, New York, N. Y.

July 16-18—Lunar Missions Meeting, American Rocket Society, Pick Carter and Statler Hilton Hotels, Cleveland, Ohio.

Aug. 21-24—Western Electronics Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.



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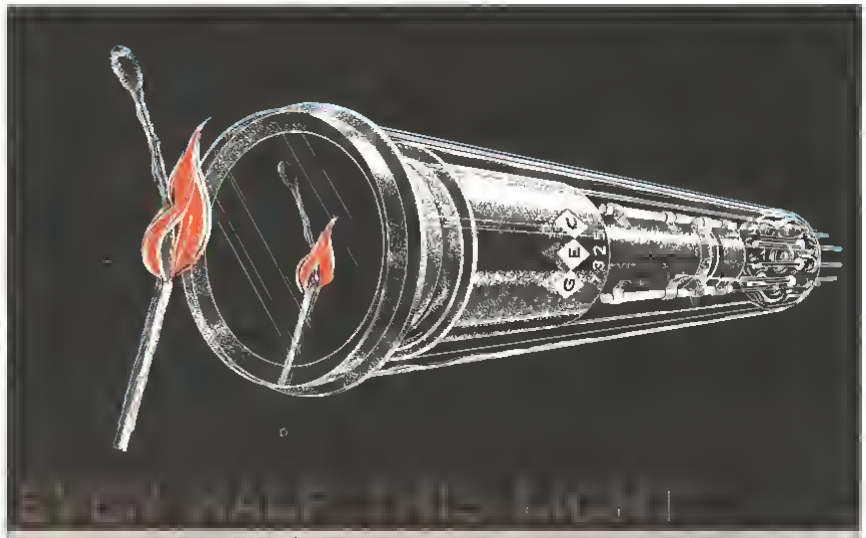

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GEC 1343 Ruggedized Electrostatic Focus and Deflection Vidicon with same electrical characteristics as the 7522

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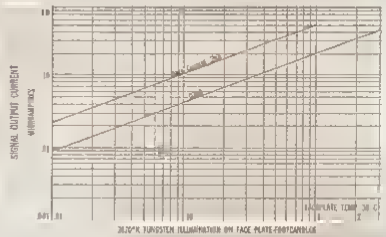

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January 8, 1962

Aviation Week and Space Technology

Vol. 76, No. 2
Member ABP and ABC

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COVER First published photo shows Lockheed C-140 military version of four-turbojet JetStar utility transport in Military Air Transport Service markings Total of six C-140s have been ordered for the 1254th Air Transport Wing Special Air Missions MATS from Andrews AFB Md C-140 recently averaged 590 stat mi per hour ground speed on a 2,660 mi nonstop proving flight from Ontario, Calif, to Boston (See p 67 for story and photos)

PICTURE CREDITS

Cover—Turner Hiers Lockheed 27—Aviation Week 29—Cessna 37—Sikorsky 39—J A. Wolf 43 45—Basle Airport 50 51 53 55—NASA 59 61—Israel Aircraft Industries 67 73 74—Lockheed 78 79 80—Rolls-Royce 85 87 91 93 95—Motorola

86,949 copies of this issue printed

EDITORIAL

Bold Enterprise

(Dr Hugh L. Dryden, deputy administrator of the National Aeronautics and Space Administration, recently told the Manned Lunar Flight Symposium, sponsored by the American Astronautical Society at the 128th meeting of the American Association for the Advancement of Science, that manned exploration of the moon is "one of the boldest enterprises ever undertaken by any nation." AVIATION WEEK is presenting excerpts from Dr. Dryden's discussion of the national and international significance of the lunar program because, as he noted, "this task will require the resources and skills of scientists, engineers, technicians, business specialists and managers in government, industry and education, and the marshalling of their knowledge now available and to be obtained within the next few years in almost every branch of science, engineering, technology and management.")

The space activity is at present wholly financed by the government, and from the beginning over-all governmental policy considerations have determined the nature, scope, and rate of advance of space science and technology and of their application to fulfill various national needs. A positive decision was made to entrust the development of space science and technology and their civil applications to a civil agency while reserving applications to national defense as the responsibility of the Defense Department. It becomes apparent that the government has full power to set the national goals in space. In fact, it already has established goals which motivate large elements of the nation to expand the new science and technology as rapidly as possible. It is also clear that the wise direction of the space effort may be used as an instrument of social change in many areas of economic and social development of the nation if so desired. Finally, it is clear that such policy decisions are established through the cooperation of the legislative and executive branches of the government and must ultimately receive the support of the public. Thus the primary significance of the national space program is that it is a powerful instrument of governmental policy such that the social and economic impact of the new technology can be channeled to desirable ends.

The sheer magnitude of the manned lunar exploration program, amounting as it will to $30 billion or more, represents a significant application of the nation's resources. These billions of dollars will be spent in the laboratories, workshops, and factories of the nation and thus constitute a significant factor in the nation's employment and economy generally. The personnel in the space program are not all scientists and engineers but come from every walk of life.

The ultimate and practical purpose of these large expenditures is twofold: (1) insurance of the nation against scientific and technological obsolescence in a time of explosive advances in science and technology; and (2) insurance against the hazard of military surprise in space.

The first result can be accomplished because of the technical nature of the program and the demonstrated transferability of scientific and engineering knowledge to other industrial applications. Manned exploration of the moon requires the most advanced engineering and technological developments at the very frontiers of knowledge. Major advances are occurring in electronics and communications, new materials, energy sources, and energy-conversion devices; data collection and handling, computers; knowledge of the behavior of the human body under stress, protective equipment for man in hostile environments, and many other areas.

The manned lunar exploration program constitutes essential insurance against finding ourselves with a position in the new technology inferior to that of a possible enemy. The freedom of space combined with the great power of nuclear energy for destruction forecasts the future development of weapon systems now only dimly understood. There are many defense applications already evident and undertaken as a responsibility of the Defense Department. The components, vehicles, techniques and knowledge developed in the civil program are constantly available for defense applications.

Space exploration is a significant factor in international policy. From the beginning space activities have had an impact on the climate of world opinion with respect to national strength and prestige. As stated by the President's Science Advisory Committee in March 1958: "To be strong and bold in space technology will enhance the prestige of the United States among the peoples of the world and create added confidence in our scientific, technological, industrial, and military strength."

There are no short cuts to the attainment of the desired position of strength. We have made great progress, and our policies of openness and sharing with other nations are bringing growing appreciation of the significance of our program to the free world.

In his recent speech before the United Nations, President Kennedy said: "We shall urge proposals extending the United Nations charter to the limit of man's exploration in the universe, preserving outer space for peaceful use, prohibiting weapons of mass destruction in space and on celestial bodies, and opening the mysteries and benefits of space to every nation. We shall propose further cooperative efforts between all nations in weather prediction and eventually in weather control. We shall propose finally a global system of communication satellites linking the whole world in telegraph and telephone, and radio and television." At its current session the UN adopted a resolution which represents a forward step in cooperation along the lines recommended by the President.

Some social scientists have speculated that the exploration of space might become in time a substitute for war. Hope would be that the absorption of energies, resources, imagination and aggressiveness in the exploration of space might contribute to the maintenance of peace. Whether or not this speculation is warranted, I am sure from personal experience that international cooperation in the exploration of space does contribute to friendship and understanding among nations.

We must not underestimate the significance of space exploration to the ordinary citizen in every country. You recall the complaint of the Russian workman in the Soviet Union, who asked: "What do Sputniks give to a person like me?"

To this question frequently asked by men in many countries, including our own, we can of course reply with discussions of practical benefits from weather and communication satellites and from technological developments as described in the earlier part of this paper. But perhaps a better reply would be: "The exploration of space can give you new interests and new motivations arising from an expansion of your intellectual and spiritual horizons as you take a longer view of man's role in time and space at this point in the history of the human race."

WHO'S WHERE

In the Front Office

William C. House, vice president Nuclear Rocket Systems, Aerojet-General Corp., Azusa, Calif. Also **Dr. Ernest R. Roberts,** assistant manager of Aerojet's Solid Rocket Plant, Sacramento, Calif., named a vice president.

Dr. Kenneth G. Macleish, a vice president, Perkin-Elmer Corp., Norwalk, Conn., and director of engineering of the Electro-Optical Division.

Sigurdur Helgason, president and a director of Icelandic Airlines, Inc., succeeding **Robert E. Delany,** now board chairman.

Robert L. Maple, president, Accessory Products Co., Whittier, Calif., a division of Textron, Inc., succeeding **Robert G. Rogers,** who is leaving the company.

Richard A. Hartman, executive vice president, the Palnut Co., Mountainside, N.J., a division of United-Carr Fastener Corp.

Northrop Corp.'s Norair Division, Hawthorne, Calif., has announced the following vice presidential appointments: **F. W. Lloyd,** assistant general manager-operations, and **Welko E. Gasich,** assistant general manager-technical.

William Kes, vice president-administration, Hazeltine Electronics Division of Hazeltine Corp., Little Neck, N.Y. Also **Dr. V. J. Young,** vice president-engineering, and **J. F. Willeubechei,** vice president-operations.

Robert H. Randall, assistant to the president, Kaynar Mfg. Co., Inc., Pico Rivera, Calif.

Honors and Elections

Rear Adm. Frank Akers, commander, Fleet Air, NAS, Alameda, will receive Chance Vought Corp.'s standing award of the Order of the Gray Eagle, which is given annually to the naval aviator still on active duty, having held that designation the longest in point of service.

Aerospace Division of the Martin Marietta Corp. has received the annual Industrial Science Achievement Award of the American Assn. for the Advancement of Science, based on the division's general excellence in the advancement of technological knowledge and the practical application of science through research.

Changes

Alan W. Abels, manager-export marketing, Ryan Aeronautical Co., San Diego, Calif.

Jefferson R. Wilkerson, senior engineering specialist, Reconnaissance Systems Laboratory, Sylvania Electric Products, Inc., Mountain View, Calif.

Charles D. Hawn, manager-advanced research and development sales, Maryland Division of Litton Systems, Inc., College Park, Md.

John Stone and **Harry G. Condit** have joined the staff of Northrop Corp.'s Radioplane Division, Van Nuys, Calif.

R. W. G. Emery, manager of Auckland, N.Z., International Airport, he formerly was Civil Aviation Administration regional controller for Auckland.

INDUSTRY OBSERVER

► Development of a flexible-wing paraglider capable of handling 265 lb payload and adaptable to use by a fully-equipped soldier is planned by Army's Transportation Research Command. Initial award is expected to call for construction of six vehicles.

► USAF flight evalnation of the Northrop Corp. Norair Division's improved N-156 turbojet fighter has been completed at Edwards AFB, Calif., in readiness for an upcoming selection of an aircraft to replace F-84s, F-86s and F-100s for close support and strike missions in the Military Assistance Program. Improved N-156 is powered by two General Electric J85-5 engines, developing significantly more than the previous rating of 3,850 lb. of thrust each, and incorporates improved maneuverability and stability and control with high payloads. At least one other contender is the F-104-17, a stripped-down version of the USAF-Lockheed F-104 Starfighter.

► USAF has completed an evaluation of a Soviet Mil Mi-4 helicopter at Edwards AFB. Russia has supplied this model to Egypt, Indonesia, Cambodia and other nations.

► Sweden's Saab Aircraft Co. has completed an agreement with the Austrian government for the sale of enough Saab 29s and spare parts to equip one fighter squadron. Aircraft may be assembled in Austria to aid its economy. Neither country is a member of NATO.

► Texaco Experiment, Inc., will build prototype geophysical measurement instruments for the Surveyor lunar landing vehicle under contract with NASA's Jet Propulsion Laboratory. The instruments will measure thermal diffusivity, density, magnetic susceptibility, hardness and sonic transmission on the lunar surface and in a 1-25 in.-dia. hole to be drilled in the surface.

► Annual aviation budget estimates being circulated to Britain's ministers of air, aviation and defense before submission to Parliament involved operational requirements for a V/STOL tactical freighter, possible orders for about 100 de Havilland DH-125 turbojet executive aircraft for navigation trainers, a number of Hawker P.1127 VTOL fighters and some Handley Page Dart Herald turboprop transports. Also under consideration was Royal Navy requirement for an interceptor to replace the Sea Vixen. Requirement calls for good handling characteristics at critically low speeds and probably involves a variable geometry wing designed by British Aircraft Corp.

► First launch of the USAF-Martin Titan 2 now is expected late in the first quarter of this year. First missile was due at Cape Canaveral, Fla., early this month for checkout on modified pads 15 and 16. It will be used later for actual flight.

► Firms preparing technical details and cost evaluations for a Midas missile alarm satellite automatic checkout system (AW Nov. 13, p. 97) at the request of Lockheed's Missiles and Space Division have been told to halt work pending revisions in system concept and specifications. Another briefing, originally scheduled for early December in Van Nuys, Calif., was delayed repeatedly, causing speculation that USAF might not adopt the system or might open procurement to general competition.

► Fundamentally new concepts and techniques in antenna design capable of producing significant improvement in resolution are being sought by Army Signal Corps. Industry proposals will be due early next month.

► Study of accuracy limitations of new correlation direction-finding technique with ionosphere-propagated, high frequency signals, aimed at possible use of such frequencies for ballistic missile detection, will be sponsored by USAF's Rome Air Development Center.

► Operations Research, Inc., has received a Defense Department contract for program evaluation review technique (PERT) for the costing phase of the Titan 3 space launch vehicle program.

Washington Roundup

New Budget Details

Watch for National Aeronautics and Space Administration to ask Congress for a $150-million supplemental appropriation to its Fiscal 1962 budget. NASA's Fiscal 1963 budget request will total about $3.7 billion, split this way: $2.6 billion for research and development; $800 million for new construction and $300 million for salaries and expenses. The Fiscal 1962 budget, not counting the supplemental figure, was $1.78 billion, of which $1.3 billion was for research and development, $62 million for construction and $227 million for salaries and expenses. Manned space flight will account for about 50% of the new budget.

Increase of more than 300% in the construction request is to cover new facilities at the Atlantic Missile Range, the Michoud, La., booster assembly plant and the Mississippi booster test site, all part of the manned lunar landing effort.

Defense Department's Fiscal 1963 budget request will be for $50.34 billion. Secretary Robert McNamara wanted $51.3 billion but the President, through the Budget Bureau, put pressure on to reduce it. Possible victims of the late cuts: preproduction money for Army's Nike Zeus anti-missile missile and all support and training aircraft. Late in the budget-making procedure, Defense planned to ignore service requirements for 310 North American T-39s, 40 Fairchild F-27s, 135 Lockheed C-140s and 12 Grumman Gulfstreams.

Patent Legislation

Budget Bureau is aiming at middle-ground patent rights legislation on which all government agencies can compromise. Their views on a draft version, drawn by Commerce Department, were received by Budget last week. Opinions ranged from Justice Department's position, under which government would retain extensive rights, to Defense Department's position, which would give contractors liberal rights. Industry is apprehensive that the Justice position will prevail. Basic approach of the draft proposal is to give the contractor title to patents unless the agency or department head directs otherwise. This is the approach now followed by Defense and favored by industry.

A staff report on unfair competition by foreign air carriers will be submitted shortly to the Senate Commerce Aviation Subcommittee. Closed door hearings are likely to follow. U.S. airlines have decided to alter their opposition to the legislation, long sought by the Civil Aeronautics Board, which would give it control of international rates. The carriers will propose that CAB be given authority to suspend unfair rates. The Board is expected to endorse an airline recommendation that also would give it control over capacity in international operations.

NASA Nomenclature

NASA's name for the two-man rendezvous spacecraft—Gemini—is the first of a series aimed at simplifying identification of projects and hardware, particularly the launch vehicles and stages. There is some belief that Gemini was chosen, rather than continuing the name Mercury for two-man flights, so that Life magazine's contract with the seven astronauts for exclusive rights to personal accounts of their activities would not extend through the new program. NASA had about decided on the name Kronos for its C-5 vehicle but rejected it because it is too close to the brand name of a razor blade.

Legislation restricting incentive payments on defense contracts has high priority on the House Armed Services Committee's agenda. Chairman Carl Vinson feels that incentive payments frequently have resulted from original excessive cost estimates rather that contractor performance. General Accounting Office will submit several reports citing instances of this.

Senate Permanent Investigating Subcommittee expects to hold public hearings late in February on management performance of Air Force and contractors in construction of missile bases. Efficiency and profits will be the focal points.

Minetti's Membership

President Kennedy last week renamed Alan S. Boyd as chairman and Robert Murphy as vice chairman of the Civil Aeronautics Board but remained silent on reappointment of G. Joseph Minetti as a member. Minetti's term expired Dec. 31 but he remains until replaced or reappointed. Although failure of the White House to act led to speculation that Minetti is on the way out, no other candidates for the six-year term have been mentioned publicly.

A new mineral in the form of inclusions in granite has been discovered by Russia and named "gagarinite" in honor of the first Soviet cosmonaut. Gagarinite is said to consist mostly of rare earths.

U.S. Post Office has unwittingly helped KLM Royal Dutch Airlines in its long campaign to win landing rights in Los Angeles. Christmas cards mailed by KLM officials were posted with a commemorative four-cent U.S. stamp bearing this quote from Abraham Lincoln: "Those who deny freedom to others deserve it not for themselves."

—Washington Staff

Atmospheric Testing Awaits Soviet Action

Under new strategy, U. S. would start above-ground nuclear blasts only if Russia embarks on new series.

By George C. Wilson

Washington—Kennedy Administration is evolving a new strategy on nuclear testing which calls for putting Soviet Russia on the defensive by delaying U. S resumption of atmospheric tests until Russia embarks on another series

Top presidential advisers are recommending this course after evaluating what the Russians learned in approximately 50 atmospheric tests which ended last November. They feel that although Russia learned much from this test series, the U S still enjoys enough of an over-all edge in nuclear weaponry to refrain from immediate testing.

But so much more is learned from testing nuclear weapons in the atmosphere rather than underground or simulated in the laboratory that these same advisers feel the U S cannot afford to sit out another round of Russian tests.

President Kennedy already has ordered the Atomic Energy Commission to prepare for atmospheric tests. Those preparations are far enough along to enable the U S to resume testing shortly after it learns that Russia is preparing new atmospheric tests. But there is a tremendous psychological advantage, from the standpoint of world opinion, for the U S to delay such testing as long as possible.

Up to now, Russia has been trying to get out of the uncomfortable spotlight focused on it when it resumed atmospheric testing by pointing to U. S underground tests. Former Soviet Ambassador Mikhail A. Menshikov has indicated Russia will use the underground blasts as an excuse to resume atmospheric tests.

"If these [U S underground] tests are not stopped at once," Menshikov said, "then of course we will start our tests again—and not only ordinary bombs but perhaps super bombs also."

Russia will continue to emphasize this theme in its effort to justify another round of atmospheric testing.

President Kennedy, for the moment at least, is taking the advice of those who contend there is more to gain than to lose by delaying atmospheric testing. This strategy will be assailed by several members of Congress who feel the U S should resume atmospheric testing as soon as possible to assure that Russia does not gain nuclear supremacy. Early hearings by the Joint Congressional Atomic Energy Committee will provide a forum for this debate.

AEC so far has released only a one-page statement explaining what Russia achieved in its tests, which ran from Sept. 1 through Nov. 4. The agency said that "although substantial progress has been made and much useful information obtained by the Soviet Union, there is no reason to believe that the balance of nuclear power has been changed to favor the Soviet Union."

However, top nuclear experts in and outside the government, interviewed by Aviation Week, stressed that the Russian tests posed grave questions for the U S. The consensus, including views of scientists who previously opposed atmosphere tests, was that the U S will have to conduct atmospheric tests if Russia continues them. At the same time, these experts said more atmospheric testing by both sides was no solution since the tests would increase the chances for war and run more fall out in the earth.

Donald G. Brennan, mathematician at the Lincoln Laboratory of the Massachusetts Institute of Technology and an authority on arms control, said the most unfortunate byproduct of the U S-Soviet testing competition is the encouragement it will give to smaller countries to develop nuclear weapons. This, he contended, will increase the chances for an accident which could touch off a nuclear war.

As for the immediate military impact of the Soviet tests on the U S, nuclear authorities said these points were of primary concern:

- **Versatility of Russia's nuclear arsenal** was demonstrated by the explosion of both small and giant weapons of increased efficiency. Indications are that these weapons were both launched by rockets and dropped by aircraft.

The tests ranged from a few kilotons yield to the 55-60 megaton blast that the AEC said was fired Oct. 30, 1961, about 12,000 ft. above the ground. Dr. Ralph E. Lapp, nuclear physicist, said the fact the Russians fired the small weapons in the atmosphere rather than underground indicates they did not hold secret tests of those weapons underground during the moratorium.

AEC said "of especial interest is the small fission yield of the 55-60 megaton test." Fission is the process which splits the nucleus of an atom into two main fragments. The energy released in the process is the basis for the atomic bomb. But this splitting or fission, process also releases radioactive products which eventually come down to earth as fallout. So the less fission products which are released, the cleaner the bomb is said to be.

Fission produces the heat which explodes the hydrogen bomb. A hydrogen bomb has an atomic bomb trigger to set it off. Authorities said the reason there was such a small fission yield, or fallout, from the Russians' 55-60 megaton blast was that the giant bomb was encased in lead. This casing or damper, led to more complete burning of the bomb products and thus produced less fallout. By merely substituting a fissionable material for the lead, authorities said, the Russians would have a dirty bomb of well over 100 megatons.

AEC estimates a 100-megaton bomb dropped near the ground would severely damage residential structures for 17 mi. around and reinforced concrete structures for 10 mi. around. The heat from such a blast could burn exposed skin within a 100-mi. radius and set fire to paper and similar material for 85 mi. around. The radioactive fallout from a 100-megaton surface burst would kill a large portion of unsheltered persons as far as 620 mi. downwind from the blast. The fireball alone from a 100-megaton bomb would be seven miles in diameter.

Aviation Week encountered two schools of thought on why Soviet Premier Khrushchev wanted a 100-megaton bomb. Some feel he wanted such a weapon primarily for intimidation while others contend it was designed as a strategic weapon for use against U S. underground missile sites (see p. 25).

One military authority said it is characteristic of Khrushchev to want big products, even if they are inefficient. Khrushchev never has concerned himself with operational niceties," he said.

- **Progress made by Russia** in developing anti-missile missiles. Authorities said that although Russia exaggerated its claims about anti-missile missile development, substantial and significant information was gathered during the test series. As a result AEC now considers perfecting anti-missile techniques and making U S missiles less vulnerable to such defenses as its number one priority in nuclear weaponry.
- **New Soviet knowledge** gained through such a broad spectrum of tests. One military leader estimated that such a well-planned series advanced Russian nuclear technology by as much as a year to 18 months. He also theorized that Premier Khrushchev told his scientists from the start that they would be able to test their nuclear weapons in the atmosphere. This advance assurance saves months of development time.

In contrast to the U S., which has yet to test five the nuclear warheads of its Atlas and Titan missiles in the atmosphere, Russia in its recent tests learned a lot about the reliability and effects of nuclear weapons. One nuclear physicist said one of the biggest dividends from the test series is learning under what conditions nuclear weapons will explode.

A scientific adviser close to the President said U S nuclear weapons even though they have not been tested are considered reliable. But he said a test series such as the one Russia just conducted would enable the U S to find ways to get twice the yield from weapons of the same weights now in the inventory. Such tests would also enable the U S to revise the weapons to get the same yield for half the weight. An equally important advantage, he said would be to train U S forces in the firing and handling of nuclear weapons.

HSS-2 Speed Record

Navy Sikorsky HSS-2 set a new world 3 km. helicopter speed record of 199.01 mph. during a run Dec. 30 over a straight course at Bradley Field Windsor Locks, Conn.

The twin-turbine helicopter also held the previous record of 192.9 mph. for 3 km. (1.86 mi.), set last spring. Pilot on the new record flight was Navy Cdr. Patrick L. Sullivan, and Marine Capt. David A. Spurlock was copilot.

The 3 km. mark was the fourth speed record established by the HSS-2 during December, out of five recognized world marks. The helicopter established three new records on Dec. 1 when it flew 182.8 mph. over 100 km., 179.5 mph. over 500 km., and 175.3 mph. for 1,000 km.

Vought Homes Sale

Ling-Temco Vought will sell Vought Industries Inc., mobile homes manufacturer to Divco-Wayne Corp., New York. LTV management terms the sale another move to simplify its structure and permit heavier concentration on aerospace and allied electronics activities.

The Vought Industries sale has been arranged for an undisclosed amount of cash, estimated at approximately $11 million by sources close to the transaction, and a nominal amount of stock. James J. Ling, a director and chairman of LTV's executive committee, will be nominated as a director of Divco-Wayne.

LTV last year disposed of National Data Processing Corp., and is in process of disposing of Information Systems Inc.

Apollo Guidance Bidders Protest NASA Choice of Non-Profit Firm

By Philip J. Klass

Washington—Manufacturers of stellar-inertial guidance systems are seriously disturbed over National Aeronautics and Space Administration's selection of Massachusetts Institute of Technology's Instrumentation Laboratory to develop the Apollo spacecraft navigation system without the normal competitive bidding process.

The NASA action has focused attention again on the growing question of government supported, non-profit organizations competing with private enterprise.

Most of the disgruntled manufacturers expect to compete for a NASA contract to produce the system which MIT develops, and therefore are reluctant to comment publicly. But generally, industry criticizes NASA's action on one or more of the following counts:

- **Choice of a non-profit organization** at a time when industry has talent and capacity to spare.
- **Selection on a sole-source basis** without competitive bidding.
- **Sudden reversal of NASA policy** after guidance contractors say they had been led to expect competitive bidding and after many had spent considerable funds on studies and proposal efforts.

Manufacturers' Complaints

One company spokesman said: "If NASA originally had announced that the Apollo guidance was to be awarded on a sole-source procurement basis giving us at least a chance to appeal the decision even if our appeals were overruled, we would not feel so bitter. Or, if NASA had held a competition and MIT's proposal had been judged superior, we might have groused a bit and we would not have as strong a complaint."

An official of another guidance firm summed up his company's views this way: "If this nation wants as it certainly must to maintain a talented inertial guidance industry, then the NASA award to MIT works hand against such an objective. As the number of new systems having inertial requirements becomes more limited, the award of a job like Apollo to a non-profit competitor leaves the industry hurting and wanting."

This emphasizes one of the reasons why industry is so concerned over the NASA action. Today the number of companies with inertial development and production capability appears to exceed the nation's present military and space needs. If a competition had been held, about a dozen companies were expected to submit bids.

More outspoken criticism has come from C. W. Perelle, president of American Bosch Arma Corp., whose production of inertial guidance for the Atlas is nearing an end, with no major replacement program in hand.

In a letter to Rep. Steven B. Derounian (R.-N.Y.), Perelle said of the NASA award to MIT on a sole-source, non-competitive basis: "While this is permissible in accordance with existing legislation and therefore not challengeable, nor is it the intent to do so in this letter, it does pose serious problems for competitive enterprise."

Speaking of the role of non-profit organizations, Perelle said: "Many company managements firmly believe that such organizations, particularly the nation's colleges and universities, can contribute greatly in the basic research field but are equally strongly convinced that the application of this research to the design, development, testing and manufacture of products is an industrial function."

In a letter to President Kennedy, Rep. Derounian brought the matter to the President's attention and said: "I trust that you will have an investigation made of this economically unsound decision of NASA so that it will not be repeated in the future. There is no justification nor any sense of fair play in having outstanding companies spend their man-hours in developing a concept and then having the door unceremoniously closed on them."

Subsequently an Arma employee wrote to Sen. Jacob K. Javits (R.-N.Y.), whose office sought an explanation from NASA. In its reply, NASA justified its action as follows: "The Apollo guidance and navigation system is one which requires careful and competent development, and to ensure this NASA made a careful review of the national capability. As a result of this review it was decided that the MIT Instrumentation Laboratory was to receive the responsibility of design and development of the system."

The reply pointed out that when NASA issued its request for proposals on the Apollo spacecraft on July 28, it announced that the guidance and navigation system would not be developed by the spacecraft contractor.

"With the results of the review of the national capability in mind, NASA reached the conclusion that the MIT Instrumentation Laboratory offered the best source for the development of the guidance and navigation system, and on

Aug 9, 1961, it was announced that this laboratory had been selected," the reply said

A prompt decision and announcement was made to attempt to prevent a situation wherein certain industrial concerns might expend additional time and effort The NASA staff feels that it has done everything possible to make its position clear in order to head off extraneous efforts by industry over and above what would be generated by natural enthusiasm "

In February, NASA had awarded a $100,000 contract to MIT for "research, development and laboratory studies of guidance-navigation system" for Apollo This was similar in nature to the three spacecraft feasibility studies done for NASA by Martin, General Dynamics and General Electric Industry representatives say that working level engineers in NASA encouraged companies to put their own funds into similar guidance studies with the assurance that the job would be thrown open to competition One company said that after hearing rumors that the subsequent contract for Apollo system design and prototype fabrication might go to MIT, it checked NASA only a few days before its Aug 9 announcement and was assured that a competition would be held as previously planned

An official of another company speaks of the thousands of dollars spent on study and proposal effort "when well-meaning working level NASA scientists advised industry of Apollo requirements Then in a 'summit powerplay,' the job went to MIT, leaving industry and its personnel discouraged and with some sizable expenses to absorb "

MIT Selection

The question of why NASA decided to select MIT's Instrumentation Laboratory was put to Cdr H E Van Ness, who joined the agency in July to head Apollo guidance Van Ness pointed out that design of the Apollo guidance-navigation system was a very difficult problem and one that required an extremely high level of competence and imagination

He also contended that the development had to be done on an extremely tight schedule

Cdr Van Ness said the Instrumentation Laboratory and Dr C Stark Draper, its director are acknowledged leaders in the field and, on the Polaris program, have demonstrated their ability to meet difficult objectives and adhere to a tight schedule He said that NASA had first checked with the Navy to assure that the Apollo program would not divert Instrumentation Laboratory talents from Polaris It NASA had held a competition for the Apollo system, MIT's own ground rules would not have allowed it to bid in competition with the industry, he said

Dr Draper told AVIATION WEEK that NASA had asked the Instrumentation Laboratory to take on the Apollo program He said MIT did not submit a proposal to the agency He pointed out that as a non profit organization, the Instrumentation Laboratory does not have the funds or the manpower to prepare large expensive proposals But he said that MIT did "put together some material indicating how we would do the job" in response to a NASA request

Air Force Study

Earlier, MIT had been working on an Air Force-sponsored study of the navigation system required for the Mars probe spacecraft involving the use of inertial, optical, radio and radar guidance techniques When NASA was formed and assumed the space role the MIT study was placed under NASA's cognizance

In response to industry criticism of the NASA action, Draper said that MIT normally does not take on jobs that can be accomplished with existing techniques and hardware but limits itself to problems requiring development of new techniques The Instrumentation Laboratory, Draper said, works on hardware and techniques which are "well out in front of what industry is doing "

The Apollo navigation guidance system will require very advanced approaches and therefore qualifies for Instrumentation Laboratory consideration, Draper said

The present MIT Apollo guidance contract is for $4 375 000 During the next decade the extent of MIT participation might total $30-40 million, Draper estimates

Ironically, many of the companies in the inertial field some of which are critical of the Apollo award, owe much to the early work by Draper and his associates at MIT The floated integrating gyro, developed there, is a major production item with companies such as Minneapolis-Honeywell and Kearfott Division of General Precision The AC Spark Plug Division of General Motors and the Ordnance Department of General Electric both entered the inertial field by being selected to manufacture systems developed by MIT Sperry Gyroscope and North American Autonetics are building submarine inertial navigation systems (SINS) first built by MIT

In the early postwar years, when a 100 to 1 or better improvement in gyro accuracy was needed to make inertial guidance feasible Draper and his associates were among the handful of pioneers who felt it could be done No one questions the important role that the Instrumentation Laboratory played in developing inertial guidance techniques in the postwar years But there are some who feel that the contributions of other early pioneers have not been adequately recognized

There also is increased questioning of the role of the Instrumentation Laboratory, now that its early efforts have come to fruition and a broad industrial competence has been established in the guidance field

If NASA has decided that the Instrumentation Laboratory will be its sole source of guidance know-how for development industry fears that its better engineers and scientists who want to work on such challenging problems will leave to join MIT If such an exodus occurred, the result might be a single source of development competence in the nation industry sources say

Industrial Contractor

NASA has sought to soften the blow by pointing out that MIT will only build the first few Apollo navigation-guidance systems and that an industrial contractor will be selected within six months to work with MIT and to produce subsequent systems MIT also will buy some of the hardware for the first few systems from industry NASA says

This has prompted some inertial guidance companies to avoid public criticism But others, such as Anna appear concerned also over their chances of being selected for production of subsequent systems because of their split with Draper over the best techniques for inertial system design

All the inertial systems developed by MIT in recent years have used the single-axis floated integrating gyroscope and many have used a gyro type of integrating accelerometer

Several companies, including Anna, favor the use of two-degree-of freedom type of gyros which involves fundamentally different design concepts Although these companies obviously would not refuse the opportunity to build an MIT design for Apollo, there is some concern that their past differences with Draper over the best inertial design technique may hurt their chances of being selected for Apollo production

SRN.2 Tethered Flight

London—Saunders-Roe SRN 2 Hovercraft currently being considered by the U S Navy (AW Dec. 25, p 13), made its first tethered flight Dec 29 at East Cowes, Isle of Wight Test was aimed at routine ground running of the four Black burn Nimbus gas turbine engines when pilot Peter Lamb decided to lift off Actual operational testing will start near the end of January Vehicle weighs about 27 tons (AW Dec. 11, p. 115)

Russia Seen Relying on Big Warheads

Washington—New theory on Soviet strategy for deployment of intercontinental missiles is evolving, based on recent USSR tests of nuclear warheads up to 55-60 megatons and earlier tests of a new series of Soviet ICBMs using a new guidance system

If the theory is valid, it would explain why the much-heralded "missile gap" has not materialized in terms of comparative numbers of U S and Russian ballistic missiles But it would raise the possibility that the gap does exist in terms of the comparative warhead yield which each can transport by ballistic missile today

There is a growing view that the Soviet Union, in contrast to the U S strategy of building several thousand ICBMs with low-megaton warheads, has decided to build only a couple of hundred large ballistic missiles with high-yield warheads

Basic Differences

These basic differences in strategy do not imply that either country has made an incorrect choice, but reflect the many differences in the military problems faced by each and the industrial capability each has with which to meet the problems

There also is speculation that the large-yield warheads may have been adopted as a countermeasure against an anti-ICBM system The large-yield warhead could be designed to detonate at extreme altitudes—before there is time for an anti-ICBM missile to reach intercept altitude—and still produce considerable blast and radiation damage to unhardened facilities and population centers

There are many factors which would make such a Soviet strategy a logical one, the current theory holds One is the fact that a very high percentage of U S industrial facilities and population are centered in a relatively few high density areas whose locations are known These are the types of targets vulnerable to high-yield warheads

In contrast, the Soviet Union's manufacturing facilities and population are more widely dispersed—a situation that began during World War 2 With more limited knowledge of the location of key Soviet military targets the U S must resort to more of a shotgun type of strategy

In an effort to assess the consistency of the new theory regarding Soviet ICBM strategy, military observers have analyzed it both from a first-strike and a second-strike Soviet point of view

If the Soviet strategy is to launch an all-out nuclear war, and if the USSR's military planners believe they soon will have an effective anti-ICBM defense as they have stated publicly on several occasions then the strategy of a comparatively few large-yield weapons appears to make good sense

The difficulty of launching a precisely synchronized ICBM attack increases geometrically as the number of missiles that must be launched increases, particularly if they are liquid-fueled missiles Furthermore, the larger the number of ICBMs the more likely they are to be detected by the U S Ballistic Missile Early Warning System and other detection systems

If one or two Soviet ICBMs should be launched prematurely, they could give away the impending attack and bring down a rain of retaliation which would destroy many Soviet missiles

By using a small number of ICBMs with warheads of very high yield, Russia might hope to wipe out a sizable number of U S missiles and bombers and create such chaos in military command that few of the undamaged missiles and bombers would get off. Of the relatively few that did, the Soviets would hope to destroy most of them with their anti-aircraft and anti-ICBM defenses, accepting a comparatively small amount of damage from the few that did penetrate their defenses

If the Soviet Union does not plan to initiate a nuclear attack, but is fearful that the U S might then the strategy of a few large-yield ICBMs also appears beneficial for several reasons

First is the drain on its economy of building thousands of missiles and constructing hardened underground silos. The task of rebuilding factories and homes destroyed in the war, plus constructing new factories, roads and apartments under pressures for improved living conditions has put great strains on the Soviet Union's construction capability A Soviet Embassy representative in Washington following an address to a local engineering group, was asked why Russia had so many dirt roads He replied that paved roads were a luxury that the USSR could not afford on a wide scale today

The cost in labor and materials of building 300 underground silos for large high-yield ICBMs is considerably less than the cost of building 3 000 silos for the same number of lower-yield ICBMs Additionally, the cost of providing hardened communications, command and control facilities and all of the direct support equipment needed for missile launch sites is reduced by a significant factor Also, the number of skilled missile technicians is proportionately reduced

Secrecy also favors the smaller number of higher-yield missiles from the Soviet point of view It is far easier to obscure the tell-tale signs of construction of a single missile silo than a large complex

The Russians as might be expected in a tightly stretched economy like to obtain widespread use from a single basic design This has been evidenced in their military aircraft, which often are adapted with only slight modification to transport use

Having publicly committed itself to the space race with the U S, the Soviet Union will need large boosters for its space missions The same large boosters with perhaps slight modification could be used for ICBMs and space probes

The degree of hardening and dispersal planned for Minuteman ICBMs presumably was based on the assumption that Soviet ICBMs would carry warheads with yields in the five to 10-megaton range

The higher yield warheads naturally would increase the vulnerability of an individual missile site, but not directly proportional to the increased yield For example a 100-megaton explosion is believed to produce little more than twice the blast pressure of a 10 megaton warhead (AW Jan 1, p 39)

British Merger Talks Delayed

London—Talks leading to formation of a joint guided weapons company by British Aircraft Corp and the Fairey Co have been delayed until firm decision is made on merger bid for Fairey by Bristol Aeroplane Co and Westland Aircraft (AW Jan 1, p 18).

BAC and Fairey had neared final agreement on formation of the joint weapons company aimed at massing their technologies for design and development of the Fairey Swingfire, an anti-tank weapon which has drawn considerable Ministry of Aviation interest. Weapon details are secret, but Swingfire probably dispenses with the wire-guiding system employed by the Vickers Vigilant.

Fairey directors last week recommended that stockholders turn down the $12-million Bristol Westland merger bid contending the offering price is too low and does not consider Fairey's future profit making potential Meanwhile, BAC-Fairey talks are in abeyance, pending final decision by Fairey stockholders

Early Task Group Studies Guide Manned Lunar Landing Program

Washington—Major critical areas and pacing items in the Apollo manned lunar landing program, identified a year ago are still valid and continue to guide current decisions according to Dr Hugh L. Dryden deputy administrator of the National Aeronautics and Space Administration

The White House decision to accelerate the Apollo program was made in May but internal NASA studies completed the previous January shaped the program and are serving as the basis for its detailed planning, Dr Dryden said

In a chronological summary of the lunar exploration program, Dr Dryden told the American Astronautical Society Lunar Symposium in Denver (see p 17) it was determined from early studies that the pacing items would be development of launch vehicles and facilities, not development of the spacecraft Other special problem areas immediately identified were guidance and navigation systems development of a heat shield to survive escape velocities, safe moon landing radiation and weightlessness, and moon habitability and survival

Immediately after an acceleration of the Apollo program was approved by President Kennedy, Dr Dryden said an ad hoc task group was formed to determine the scope schedule, funding main problems pacing items and major decisions required at various time periods

The ad hoc group which reported June 16, concluded first that a strong management organization was required and that information was needed at an early date on radiation protection and lunar surface characteristics Pacing items, the group said were award of development contracts for boosters, static test stands for these vehicles, and launch facilities

A second group was formed May 25 to survey launch vehicles This group reported June 10 A joint NASA-Defense Department study on potential launch sites began June 23 reporting in July NASA and Defense Department decided July 20 to form a joint Large Launch Vehicle Planning Group, which became known as the Golovin Committee

The Golovin Committee's basic recommendation was that the rendezvous approach should be used in the manned lunar landing mission (AW Nov 6, p 26), a recommendation which has been accepted by NASA (AW Jan 1, p 16)

Dr Dryden described 1961 as "a year of great national decision." The last five months of the year brought these decisions in the lunar program

- **Atlantic Missile Range** was selected as the Apollo launch site on Aug 24
- **Michoud La.**, facility was selected to construct Saturn S-L, S-1B and Rifts vehicle stages on Sept 7
- **S-2 vehicle stage** was awarded to North American Aviation, Inc on Sept 11
- **Houston** was selected as the site for NASA's Manned Spacecraft Center on Sept 19
- **Mississippi Test Site** at Pearl River was selected to static test booster stages built at Michoud on Oct 25
- **Brainerd Holmes** was appointed to head the vastly expanded manned space flight management office on Nov 1
- **Chrysler Corp** was awarded the contract to build the S-1 Saturn stage on Nov 17
- **North American** was awarded the contract to build two Apollo modules on Nov 28
- **Two-man Mercury-type capsule** received final headquarters approval and a contract for the capsule was awarded to McDonnell Aircraft Corp Decision to launch the spacecraft with a Titan 2 vehicle was made Dec 7
- **S-1B booster award** was made to Boeing Co on Dec 15
- **S-4B vehicle stage award** was made to Douglas Aircraft Co on Dec 20
- **Apollo launch vehicle configuration**—five engines clustered in both first and second stages and a single engine in the third stage—was selected Dec 22

Dr Dryden said the decisions which have been made will initiate work on the pacing items for the rendezvous method but NASA also has decided to begin work on the longest lead-time items for the direct ascent method to allow a change in plans if problems develop in the rendezvous method

He said NASA is giving consideration to development of a large hydrogen-oxygen engine of a million or more pounds thrust

This is the engine recommended by the Golovin Committee after NASA had received unsolicited proposals from Aerojet Pratt & Whitney and Rocketdyne (AW Oct 23 p 27) NASA had planned to award the contract for the engine which carries the designations Y-1 and M-1, before the end of 1961 However this plan was made before the firm decision to emphasize the rendezvous approach

Glenn Flight Delayed

Washington—Three orbit manned Mercury flight with Astronaut Lt. Col John H Glenn as the pilot has been delayed a week because of minor problems in the Atlas launch vehicle Booster difficulties caused a 2-3 day delay and a decision was made to re-schedule the launch for Jan 23

National Aeronautics and Space Administration schedules its Mercury launches on Tuesday so that the Navy can deploy its recovery forces on Monday The recovery force for this launch designated MA-6 includes three aircraft carriers and about 15,000 men

Russia Plans Lunar Industrial Complex

Moscow—Soviet Union hopes to establish an industrial type complex on the moon following a space flight program the same as the U S has charted in which manned earth orbital flights manned circumlunar flights instrumented lunar landing packages and manned lunar landings are planned in the next few years

A broad outline of the plans was reported in Tass Pravda and Izvestia on Dec 31 Unidentified designers are quoted in Tass as saying that improvements are required in spacecraft design to provide better environmental conditions for cosmonauts, improved radio communications flight control, and instruments to study cosmic and solar radiation propagation of radio waves and micrometeoroids

It is hoped that on prolonged flight through space the cosmonauts would be "able to conduct some scientific experiments right on board the ships," the Tass report said

Izvestia, devoting one of its six pages to material supplied by editors of a new journal called "Aviation and Cosmonautics" (AW Oct 23 p 21) highlights a report which says unmanned stations will be landed on the moon in the not-too distant future

The U S plans to launch its hard-landing Ranger 3 lunar vehicle late this month

USSR instrument landing mission according to Izvestia will be followed by "manned flight to the moon establishment of a permanent scientific station on the moon and ultimately by an industrial type installation."

"Then will come flights to the nearest planets of the solar system—Mars and Venus—which may well be achieved within the next few years."

Although Russia has never emphasized the practical aspects of space as the U S has done in its Tiros, Transit and communications satellite programs, Pravda says a satellite system can be anticipated shortly for weather, navigational and communications purposes

Titan 3 Proposed for Space, Weapon Roles

Titan 3 is projected for use as a space-weapon booster with fast reaction time and as a missile to mount a very heavy warhead, in addition to serving as a booster for space experiments

The basic Titan 3 configuration will be composed of a two-stage Air Force-Martin Titan 2 core fueled with storable nitrogen tetroxide and equal mixtures of unsymmetrical dimethyl hydrazine and hydrazine, plus two supplemental 120-in.-dia solid-propellant rockets attached to the bottom stage of Titan 2

In this configuration, the dual large solid rockets would be considered stage one Stage two would be what normally is stage one of Titan 2, and stage three would be stage two of Titan 2 Other rocket units also are being considered from which to select a fourth stage for Titan 3

General development plan, costs and scheduling for Titan 3 have been firmed by Aerospace Corp as technical adviser for Air Force Systems Command's Space Systems Division under whose cognizance the launch vehicle will be developed

Estimates are that the total program may cost as much as $600-$700 million Requests for quotations from industry are expected to be issued within a short time after proposal requests are issued for the 120-in.-dia solid-propellant rocket motor—now expected some time between Jan 8 and 15, after successive delays from the original projected date of early last December

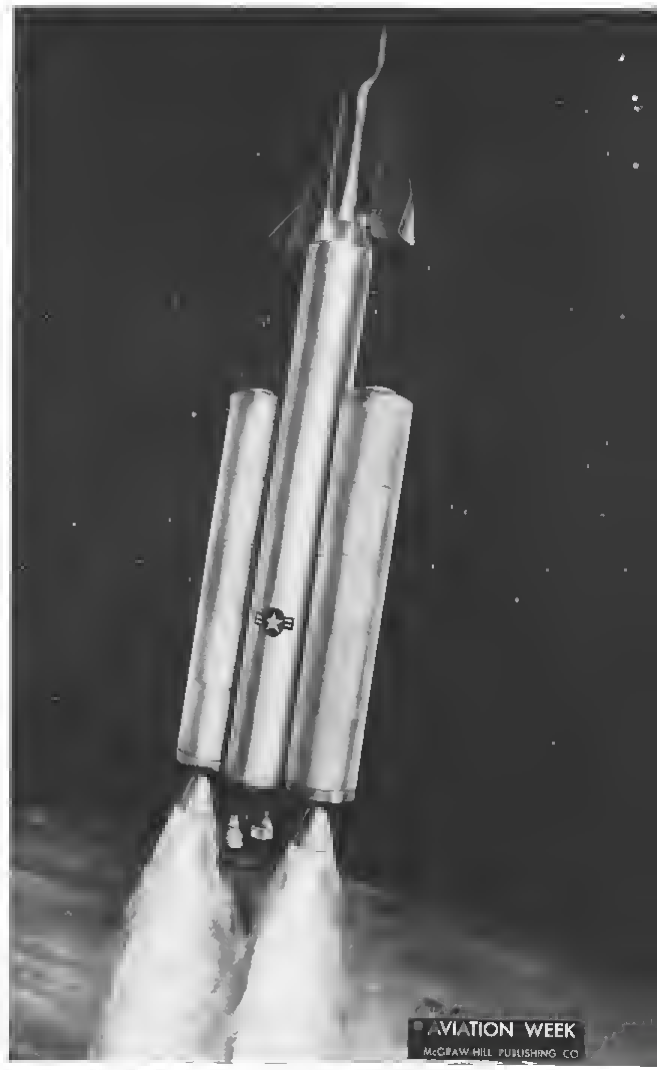
First Flight

Under present programming, first flight of Titan 3 is not expected before late 1964—after approximately 30 months of development time, which will depend on the pacing development of the 120-in.-dia solid rocket motor Initial applications for the Titan 3 are envisioned for boosting the Air Force's Dyna-Soar orbital vehicle and National Aeronautics and Space Administration's Mark 2 two-man Mercury capsule which will precede Apollo

Titan 2 core for Titan 3 will have to be modified to increase structural strength for mating with the large solid rocket cases located at opposite points of Titan 2's diameter This will involve an over-all weight increase of approximately 3,400 lb., with 2,850 lb for the bottom stage and 550 lb for the upper stage

Titan 3 configuration will embrace a variety of development possibilities

- **120-in. solid-propellant rockets** might be used in both three-segment and five-segment arrangements, depending on mission requirements.
- **Five-segment**, 120-in.-dia solid rocket



AVIATION WEEK artist's concept shows basic arrangement of Air Force's projected Titan 3 booster with Dyna-Soar orbital vehicle as payload This Titan 3 configuration envisions use of dual five-segment, 120-in.-dia solid rockets as first stage, with Titan 2 core serving as stages two and three. Other stages such as hydrazine-fluorine hydrogen-fluorine and hydrogen-oxygen rockets and Agena D, also are being considered as additional top-stage propulsive units for Titan 3.

will be about 70 ft long—about the same length as the Titan 2 bottom stage, which also is 120 in in diameter The five-segment rocket will develop approximately 1 35 million lb thrust Burning time would be approximately 100 sec Thus, total thrust of the Titan 3, using five-segment solid boosters, would total approximately 3 23 million lb , with 2 7 million lb for the two five-segment solid boosters, 430,000 lb for the second stage (bottom stage of Titan 2) and 100,000 lb for the third stage (second stage of Titan 2)

• **Three-segment,** 120 in dia solid-rocket would develop a thrust of approximately 0 9 million lb and probably would burn for 70 to 80 sec Length of the three-segment configuration would be approximately 52 ft

• **Typical capability** of Titan 3 using five segment solid rocket boosters would be to boost a 32,000 lb payload into a 150-naut-mi altitude orbit in downrange launch from Cape Canaveral, Fla To achieve a 300-naut mi-altitude orbit payload capability would decrease to approximately 29,500 lb

• **High-energy stages** using hydrazine-fluorine hydrogen fluorine or hydrogen oxygen as propellants are being analyzed as fourth stages for Titan 3 to increase payload capabilities. Research and development with liquid rockets using these fuels is being supported by the Air Force and also under company funded programs by some rocket firms

• **Use of Lockheed's Agena D** as a top stage for Titan 3 is another possibility The Titan 3 using the five-segment solid rockets with Agena D as the top stage on the Titan 2 core probably could place approximately 3,500 lb into a synchronous equatorial orbit, or place about 8,000 lb into an escape-velocity trajectory For a variety of orbit injection conditions, Titan 3 components—Titan 2 core the three-segment solids and the five-segment solids—together with Agena D in the various combinations possible could provide a wide range of performance capability for space missions

Titan 3 isn't seen as the ultimate launch vehicle for the Air Force in the foreseeable future Larger vehicle configurations already are envisioned based on solid rocket boosters even larger than the 120-in -dia rocket projected for Titan 3 Aerospace Corp has submitted to Air Force and Department of Defense a work statement for a 156-in -dia solid-propellant rocket motor with recommendations that it be developed up to preliminary flight rating test Industry observers anticipate that this 156 in. solid may become a workhorse booster for the Air Force

In the same work statement, Aerospace Corp also has presented plans for an analysis (study project) for a 240-in -dia solid propellant rocket leading perhaps to development of one or two prototypes for firing trials NASA presumably would be the potential customer for this 240-in motor

Hallamore Electronics manufactured the 7.3-lb. television camera, which has a 30-deg view angle This camera, which will transmit to monitors at Hangar AE at AMR, has a 600-line resolution in the center and 300-line resolution at the corners It will not be ejected or recovered

The recoverable camera capsule is made of aluminum with a nylon ablative material covering It is scheduled to impact 250 mi northeast of San Salvador Primary recovery method will be by Grumman SA-16 Technique is for the aircraft to land on the water and retrieve the canister, which will be equipped with a radar reflector and a homing beacon.

Douglas Asks Excess Profit Tax Refund

Los Angeles—Douglas Aircraft Co has filed a complaint against the government in the U S District Court here for refund of $3,126 433 75 in excess profits taxes paid for 1951 1952 and 1953 Similar suits are in the process of being filed by other defense contractors.

Douglas attorneys list five issues in the complaint four of which involve "total assets" and the basis for computation of total assets on certain dates used for tax purposes The issues are

• **Whether or not** the purchase price of a portion of the Douglas Long Beach facility was includable in total assets as of Nov. 30, 1946 a date used for tax computation purposes

• **Amount to be included** in total assets with respect to accounts receivable under cost-plus-fixed-fee government contracts

• **Amount to be included in total assets** with respect to inventories of work in process under fixed fee government contracts

• **Includability of certain refunds** of U S taxes receivable but not yet collected by Douglas

• **Whether Douglas meets** the requirements of a relief statute contained in the excess profits tax act based on an increase in Douglas' capacity for production between Dec 31, 1946 and Dec 31, 1949

Outcome of Douglas' attempt to recover the excess profits taxes is of considerable interest to other companies taxed under the same act Of special interest, because of its wide application, is the third issue on the amount to be included in total assets with respect to inventories of work in process under fixed-fee government contracts, according to Douglas tax counsel Bruce Hunt

The district court upon receipt of the Douglas complaint, has given the government the customary 60 days in which to reply

New Echo Sphere to Be Launched

Washington—Ejection and inflation of a 500-lb , 135 ft dia inflatable sphere will be tested this week by the National Aeronautics and Space Administration in a development launch of a rigid Echo sphere from the Atlantic Missile Range

The USAF Douglas Thor launch vehicle to be used in the test is a standard Thor missile modified with an attitude control system and a camera housing The Thor will follow the payload after separation and photograph inflation of the balloon with television and movie cameras located in the forward housing The movie camera pack will be ejected and recovery of the camera capsule is planned

The sphere is an advanced version of the Echo 1 passive communications satellite which was launched Aug 12, 1960, and is still in orbit The advanced Echo test is nicknamed Big Shot (AW Dec 25, p 11), and is the forerunner of an orbital launch scheduled this summer as the payload of a Thor Agena B from the Pacific Missile Range

The sphere, made by the G T Schjeldahl Co , consists of two layers of Alcoa aluminum foil each 0 00017 in thick, laminated to Mylar with a thickness of 0.00069 in The foil is coated with alodine, a substance designed to provide thermal balance

Inflation will be accomplished by accelerated a sublimating powder Approximately 50 lb of the powder will be packed in the sphere When inflated the balloon will have a skin stress of 4,000 lb per sq in and the internal pressure will be 0 004 psi The balloon payload will be packed in a 70 lb magnesium alloy canister, oblate spheroid in shape, which was manufactured by Grumman Aircraft and Engineering Co The canister has a 44-in dia and is 36 in. high.

The sphere is scheduled to reach an apogee of 950 mi and should be visible from a large part of the eastern U S Launch is scheduled for 6-7 a m Tuesday A morning launch is planned to permit maximum daylight for recovery of the camera capsule

Space Recovery Systems Inc , developed the recoverable camera capsule The camera is a high resolution Milliken 16mm. camera with a 12 5mm, f 2 5 lens made by the Kinoptik Co of France The camera weighs 12 lb , and will operate for about 12 min

Mission Capability of Cessna T-37 Expanded

Cessna Aircraft Co's T-37 primary jet trainer mission capability has been expanded under a company-funded program Trainer now can be equipped for gunnery rocket bomb and photography missions Equipment now available comprises an armament system consisting of two general purpose armament pods manufactured by General Electric Co The pods can be attached to pylons mounted under each wing and can be jettisoned Aircraft displayed above carries civil registration

Synchronized Ranger TV Cameras To Photograph Lunar Impact Area

Los Angeles—Ranger spacecraft Nos. 6 through 9 will each carry six Videcon cameras synchronized for obtaining sequential high-resolution television photos of the lunar impact area, scientists from Jet Propulsion Laboratory revealed here before a meeting of the American Geophysical Union

These four spacecraft were added to the original series of five hard-landed Ranger vehicles described last fall (AW Sept 4, p 28) for the purpose of securing high-resolution photos

Photo Resolution

The resolution of television photos taken by these cameras is expected to be a fraction of a meter, perhaps as good as 10 centimeters, according to Albert R Hibbs, chief of Jet Propulsion Laboratory's Space Sciences Division

The Astro Electronics Division of Radio Corp of America is developing the cameras for JPL, which manages National Aeronautics and Space Administration's unmanned lunar and planetary programs

Cameras aboard the first three Rangers designed for uncontrolled lunar impacts will also provide photos of the impact area taken before landing, but not with the resolution expected from Rangers 6 through 9 Optical resolution of cameras on Rangers 3 through 5 will be three to four meters (two meters between television lines)

Approval of a plan for a series of lunar orbiters (AW Oct 17, 1960, p 27 and Aug 14, p 28) which would orbit the moon and map both its front and back sides is regarded as almost certain, it was indicated at the meeting These shots would take place during the period when the final Surveyor (soft-landed stationary vehicle) shots are attempted or immediately following these flights The orbiters, like the Surveyor series scheduled for 1963-1966, will use Atlas-Centaur boost vehicles

Resolution of the photos taken by orbiter cameras probably will not be greater than one meter for selected areas, 100 meters for an entire map

Hibbs also indicated that the Voyager series of spacecraft to be designed for interplanetary exploration, will carry highly complex planetary roving vehicles capable of performing a number of scientific missions They are to obtain and prepare planetary soil samples and perform geological, and at least on the planet Mars biological analyses

Prospector program, NASA JPL unmanned soft-landing spacecraft intended to have the capability of prowling over the lunar surface, obtaining and returning lunar samples to earth, will be reoriented—as expected—to directly assist manned lunar exploration program Prospector's roving lunar vehicle will be utilized in direct support of the manned mission and will probably include controls for remote operation from a lunar base by astronauts

NASA and JPL currently estimate that only one out of three of their unmanned lunar/planetary launches will be successful This estimate is based on a 40-60% statistical reliability associated with ballistic boosters plus the addition of at least one booster stage (like Agena B for the Rangers and Mariner R)

Jet Propulsion Laboratory is planning dual planetary launches starting with Mariner R to increase likelihood of success on these long term missions The second shot will be fired from the same pad as closely as possible after the first shot

Space Liaison Office

Washington—Efforts to increase civil military space cooperation are about to result in creation of an office for liaison between the Air Force Systems Command and the National Aeronautics and Space Administration Lt Gen Howell M Estes, Jr , deputy AFSC commander for aerospace systems, is expected to be chief AFSC representative.

This reflects the Administration's desire to smooth relationships between USAF and NASA at the working level (AW Jan 1, p 15) Administration leaders and top Air Force officials recently have insisted that AFSC be less vocal in its advocacy of a larger military space role Gen Estes requested the recent Army briefing on its space capabilities (AW Dec 11, p 29)

Aerospace Industry Backlog Drops Slightly

Washington—Census Bureau reported the value of the backlog of orders for aircraft missiles, space vehicles and engines totaled almost $14 1 billion at the end of the second quarter of 1961.

This was a 3% decrease from the $14 6 billion backlog at the end of the first quarter, 1961, and an 8% decrease from the $15 3-billion backlog shown for Dec. 31, 1960.

Aerospace Industries Assn. reported in a year-end review that the decline during the first two quarters of 1961 was somewhat below the level of sales. The association added that this trend was expected to be reversed during the last half of 1961 or early 1962 (AW Jan. 1, p. 24).

The Census Bureau reported the aerospace figures for the first time in its quarterly publication, Current Industrial Reports. Future summaries will be published quarterly although the first contained reports for the first and second quarters due to delay in receiving the industry figures.

The bureau said the third quarter summary will be ready for publication by the end of January, and the annual summary during May.

The aerospace reports supersede the Quarterly Backlog of Aircraft, Aircraft Engines and Propellers published until the end of 1960.

The separate data for missiles, space vehicles, and missile and space vehicle engines formerly appeared under the heading Other Products and Services. Data for the summary was compiled from 64 aerospace companies producing, assembling, developing or having prime system responsibility for complete missiles, space vehicles, and engines or propulsive units for missiles and space vehicles.

(MILLIONS OF DOLLARS)

Type of product or service	Backlog December 31, 1960[2]	First Quarter 1961				Second Quarter 1961			
		Net new orders[3]		Net sales receipts or billings	Backlog March 31, 1961	Net new orders[3]		Net sales receipts or billings	Backlog June 30, 1961
		Prime contract	Sub-contract			Prime contract	Sub-contract		
Total	15,321	2,515	272	3,549	14,559	2,078	255	3,822	14,059
United States government	12,056	2,235		2,740	11,551	2,429		2,897	11,093
Other customers[4]	2,265	280	272	809	3,008	639	255	926	2,966
Complete aircraft and parts, total	6,089	424	27	1,014	5,736	1,029	24	1,150	5,649
United States government	4,066	464		648	3,882	622		753	3,751
Other customers	2,023	170	27	366	1,854	417	24	397	1,898
Aircraft engines and parts, total	1,566	276	3	350	1,495	216	3	371	1,443
United States government	1,161	213		257	1,117	171		265	1,023
Other customers	405	62	2	92	378	145	3	106	420
Missile and space vehicle systems, engines, propulsion units and parts, total	4,690	1,025	93	1,290	4,528	969	100	1,327	4,270
Missiles and space vehicle systems and parts:									
Missile systems	2,855	557	6	929	2,479	616	21	946	3,170
Space vehicle systems, United States government, military	124	289	2	126	288	170	11	130	339
Engines and/or propulsion units for missiles and space vehicles (including parts), United States government, military	467	185	25	191	486	142	58	200	486
Space vehicle systems and their engines and/or propulsion units, United States government, non-military	244	4	59	32	275	41	10	51	275
Other aircraft, space vehicle and missile activities, total[4]	2,049	280	96	614	1,811	512	86	675	1,724
United States government	1,495	275		400	1,370	498		449	1,419
Other customers	554	5	96	214	441	14	86	226	215
All other products and services, total[5]	927	290	52	281	989	242	42	210	962
United States government	765	241		164	822	176		193	805
Other customers	162	49	53	97	167	66	42	117	158

[1] The backlog figures as of Dec. 31, 1960, differ from those previously published due to: (A) increased number of companies now within the scope of the survey (see above for more detailed explanation); and (B) revisions to previously reported data.

[2] New orders received during the quarter less terminations during the quarter.

[3] Includes some reported values primarily those associated with subcontracts shown under "missile and space vehicle systems, propulsion units, engines and parts," even though such values were reported as United States government orders.

[4] Includes all conversions; modifications; site activation; other aerospace products (including drones) and services not included above; and receipts for applied research and development on items such as drones, etc. Receipts for other applied research are included with figures for the respective reporting categories.

[5] Includes all non-aircraft, non-space vehicle, and non-missile products and services; and all basic research.

Avco Wins Major C-141 Subcontract

Avco Corp.'s Nashville Division, competing with five other bidders, last week won the fifth and probably the largest of the major subcontracts for the Lockheed C-141 USAF turbofan cargo transport.

Lockheed recommended Avco's bid for the wing box-beam assembly to USAF's Aeronautical Systems Division and the selection was approved by USAF headquarters. Other bidders were understood to be Douglas Aircraft Co., Northrop Co., Boeing-Wichita, Fairchild Stratos Corp., and Avro Aircraft of Canada.

The first two major systems contracts also were awarded, one to Garrett Corp.'s AiResearch Division for the environmental system, and the other to the Bendix-Eclipse Pioneer Division for the automatic flight control system to be designated the PB-60.

Like the previous subcontracts awarded, these cover only the first five aircraft but follow-ons are expected. Dollar amount of the Avco initial contract is $63 million. Twenty-one major structural subcontracts are included as part of Lockheed's package for subletting 60% of the C-141 work, with the first five considered the largest. The other four are General Dynamics-Convair for the tail section; Ruhr Aircraft, the power packages; Cleveland Pneumatic, the nose landing gear; and Bendix Products Division, the main landing gear.

Other structural subcontracts include the cargo floor, flaps, ailerons, wing leading and trailing edges, etc. Deadline for award of the last of these—the rail and roller assembly—is November (AW Oct. 9, p. 50) and the subcontracting program is on schedule.

Garrett bid the environmental system as a package, although it included four major subsystems that were bid separately by some competitors, with the number of bidders ranging from 5 to 14. Subsystems were the air conditioning, cabin pressurization, bleed air and miscellaneous pressure and temperature valves.

One system previously was awarded—the fuel gaging system to Liquidometer Corp. Seven others are yet to be awarded: electrical power generating equipment including constant speed drives, auxiliary power unit, primary flight controls, flap actuating system, fire detection, fire extinguishing and smoke detection.

Blast Effect Tested In Pershing Launch

Pershing tactical ballistic missile, first flight warhead components was successfully fired from a mobile erector launcher for the eighth consecutive time at Cape Canaveral Dec. 28.

Score for the missile is now 24 completely successful shots in a total of 28 firings.

Thermal and blast measurements were part of the Dec. 28 test. Instrumentation was placed in foxholes, behind sandbags and in the open at various distances from the launch point to measure the possible effect on troops firing the missile in the field.

Army last week awarded two contracts totaling $111,757,956 to the Orlando, Fla., division of Martin Marietta Corp. to continue work on the missile.

Pt. Arguello Tracking System Operational

Long-range radio tracking system, combining high precision automatic radar and Doppler devices is now operational at the Navy's Pt. Arguello, Calif., missile facility and will be used to provide instantaneous and more exact tracking of ICBMs launched from Vandenberg AFB over the Pacific Missile Range.

The General Electric-developed system, designated Gersis (for General Electric Range Safety Instrumentation System) is planned primarily to assist range safety personnel in following trajectory and obtaining predicted impact data on Nike Zeus/Atlas intercept test launches from Vandenberg.

However, GE officials said Gersis also will be used on PMR missile launches of other types.

Gersis will locate the missile immediately after launch and follow it through burnout providing continuous present position information and impact prediction.

In the Nike Zeus/Atlas intercept tests the system is expected to provide protection for personnel and property on inhabited islands near the missile impact areas.

The system feeds tracking data into a ground based digital computer where instantaneous determination is made of the missile's position and rate of movement in space.

Gersis supplies complete real-time impact prediction data with predicted impact point, corresponding to termination of thrust at any instant throughout powered flight, furnished as a continuous real-time display on range safety charts.

Gersis was installed at Pt. Arguello by GE's Defense Systems Department, Syracuse, N. Y., under a $3 million Navy contract.

Less Excess Profits Found in Fiscal 1961

Washington — Renegotiation Board found less excess profits on government contracts in Fiscal 1961 than in any year since the agency started full operation in Fiscal 1953, according to its annual report to Congress.

The board determined there were excess profits of $17,200,093 in Fiscal 1961 compared with $52,708,003.

The spokesman said the comparatively low figure probably is a temporary situation rather than a trend.

News Digest

International Telephone & Telegraph Corp. is making overtures to acquire Packard Bell Electronics Corp., Los Angeles, which several weeks ago reported a $9¾ million net loss for the year ending Sept. 30. Other companies mentioned as being interested in the Los Angeles firm are Litton Industries, Douglas and General Telephone.

Swiss air force plans to integrate the Hughes TARAN 1 fire control system into the 100 Dassault Mirage IIICs it has on order rather than the standard French CSF Caesar unit. An applications engineering contract was signed in Bern late last month. Firm awards are expected to follow. TARAN used in the Northrop N-156, was one of several systems including the Caesar under consideration and its tentative adoption marks a breakthrough in U.S. industry efforts to sell on the Swiss defense market.

Bids from a team of Douglas and General Electric and individual bids from General Dynamics Astronautics, Lockheed, Martin and Space General were received last week in the first phase of the Rift nuclear rocket stage competition (AW Dec. 11, p. 34). National Aeronautics and Space Administration may ask all these firms to enter the phase 2 bidding.

Soviet-made MiG-19 Farmer jet fighters, Mi-1 Hare and Mi-4 Hound helicopters and Czech-made light aircraft were paraded in Havana last week on the occasion of Cuba's celebration of the third anniversary of the overthrow of the Batista dictatorship.

Rep. Francis Walter (D., Pa.) said the Civil Aeronautics Board inquiry into the Imperial Airlines crash Nov. 9 "has disclosed shocking conditions in maintenance and operation of aircraft" by supplemental airlines (AW Dec. 18, p. 103). He said such airline operations should be closely controlled.

Carriers Fear Soaring Airport Charges

Airlines feel FAA's insistence on high fees at Dulles International may lead to increased costs elsewhere.

By Robert H. Cook

Washington—Airline concern over rising operational costs has been intensified by the possibility that the Federal Aviation Agency's proposed changes at Dulles International Airport will lead to higher airport use fees throughout the nation.

Greatest current fear is that adoption of FAA's user charge formulas and revenue use philosophy will encourage most major airports to increase their charges, providing more revenue at little cost to municipalities and greatly increased costs to the airlines. If this should happen on any extensive scale, the airlines contend, it would make a mockery of operational economy procedures suggested by Civil Aeronautics Board and rekindle industry interest in a new round of fare increases.

Magnitude of the problem, according to the estimates of one major trunkline, is illustrated by the fact that the industry's total airport expenses were only $31 million on operating revenues of $1.4 billion in 1957, but preliminary estimates of this cost for 1961 are $97 million on total operating revenues of $1.9 billion. Landing fees, which account for a minor portion of airport costs, increased 44% during this period, while revenues climbed only 37%.

Airport Profits Sought

Because of the complexities involved, there is no accepted standard of airport charges the Airport Operators Council points out. But the heavy growth of air traffic over the past decade, coupled with the expiration of nearly 50% of airline airport contracts now in effect and the desire of communities to avoid extra taxes, has caused many major cities to seek ways to make their airports not only self-sufficient but producers of revenue.

FAA, which has been severely criticized by the airlines over the proposed contract terms at Dulles and the blunt statements of Administrator N. E. Halaby, stoutly denies that it is setting any "precedent" in carrier contracts. Landing fees have been raised, counter and hangar space rentals increased and general costs to the carriers raised by many cities, either as contracts expired or as new terminal facilities were constructed. In essence, the FAA spokesman said, the agency is following the lead already established by many cities, with the major difference being that $110-million Dulles Airport is being built from the ground up to be an outstanding example of a jet age airport.

Bargaining position of the airlines with either FAA or any of the larger cities is not strong, one airline spokesman explained since Halaby is in an ideal position to press home his demands as both "landlord and policeman" for Dulles, and the airlines are economically forced to go along with airport cost increases at their major traffic generating points.

In view of the nation-wide boom in terminal construction, carriers wryly comment they have no chance of escaping higher rates when the cities insist on tearing down the old facilities. One bright spot they admit has been the general lament and mindful of negotiation over the new Los Angeles complex.

FAA so far has not set any definite rates for the airlines at Dulles, but has suggested a landing fee rate of between 25 and 35 cents per 1,000 lb. of gross landing weight. Talks between FAA and the carriers are scheduled this week on desired counter space requirements. The setting of a rental rate for this space depends on still many imponderables such as the operation of a fleet of mobile lounges and whether to assess their operation as an addition to landing fees or as a terminal building cost.

FAA Pressure Hinted

Halaby has made it clear that while FAA will consult with the industry on the final design of Dulles and the applicable rates, there will be a minimum of delay in arriving at any final figures. Halaby recently cited the possibility of having to deal with a "negative attitude" by airlines in final negotiations and the "gladiators sent out with little sprays by the carriers." He emphasized that if FAA was unable to come to definite agreements with the carriers it might be necessary to exercise a degree of "airportmanship" to convince them.

Industry sources interpret "airportmanship" as the relative negotiating strength of each party and note with reluctance that FAA is not an "ordinary" airport operator which has to bicker with a customer, but a government landlord manum to local political pressure often enlisted by the industry to avert unwanted airport increases.

An illustration of just how far FAA has pushed its authority the airlines claim is the agency's adoption of the mobile lounge concept, which the industry asked FAA to re-evaluate in April. By August the carriers proposed an alternative to the concept on the basis of an independent study in favor of a finger terminal system. While the airlines were preparing for a final meeting with FAA on this question in November, FAA announced a firm order for the equipment had already been placed.

The carriers also feel FAA acted arbitrarily by increasing landing fees at Washington National Airport from the seven cents per 1,000 lb. of gross landing weight to 15 cents. Halaby's reply was that the industry had "lived in clover for ten years" on the former rate—a position echoed around the country by many airport managements when renegotiating new contracts.

Other Increases

The agency also wants to increase hangar and counter rental rates from their present $2.10 per square foot to more than $3.50, on the premise that although Washington National has turned a profit for the past 10 years, these two areas have not contributed a fair share of the terminal's operating costs.

FAA's operational blueprints for Dulles follow the basic formula of dividing the airport into three basic areas of runways, terminal and maintenance, with the users of each separate section paying full costs in a manner similar to that now employed at such airports as Los Angeles International.

Airlines would be charged runway and hangar rental fees calculated at an estimated breakeven need for yearly operation. Interior of the terminal building would be amortized on the basis of a square footage cost with one-half the area being non-revenue-producing public area, one quarter reserved for airline counter space and the balance for concession operations. Agency spokesmen estimate that concessions to be awarded on the basis of a minimum guarantee on a long-term basis will cover nearly 80% of the airport's annual operating costs.

Airlines in the case of Dulles and other airports where rising operational costs are becoming a serious problem object to this area support concept and favor an over-all pooling of all revenues which would have the effect of holding their airport costs at a lower level.

Indicative of FAA's desire to put the operations of both Dulles and National on a self-supporting basis is its continued interest in creation of a National Capital Airport Corp. If approved by Congress this year, the independent corporation would control both airports with total revenues earned placed in a special fund for their use, as opposed to the present system of turning revenues over to the U. S. Treasury.

Stating the case for municipalities, Francis T. Fox, general manager of Los Angeles International notes: "The airport should generate enough revenue to write off its own expense. You've got to put aside a decent reserve for the future. The time is long past when you can go to the community and ask it to vote $1 million in general obligation bonds to add 1,000 ft. of runway when this competes with the need of schools and hospitals."

Fox noted a growing trend to make airports self-sufficient and supported the division of airports into the three main segments of maintenance, runway and terminal areas. Maintenance can be made self-sufficient, runways can not because landing fees are too low, but the terminal area is one that "can really make money," he said. Airports customarily operated at a loss for years, he noted, and since terminal area rentals and concessions have proven profitable in recent years cities should be permitted to plan back any realized profits into a reserve fund for future growth rather than using this money to immediately lower landing fees.

While many cities have already undertaken a program of revamping their airport contracts, Denver-Cuhl has most often been cited as an example of the city government versus the airline user debate.

More than 20 years ago United Air Lines signed a long-term contract with the city, calling for a landing fee of about three cents per 1,000 lb. of gross takeoff weight. Faced with a need for extensive airport improvements at Stapleton Field, including runway construction and additions, the city approached United and Continental Airlines with a proposal that they pay an increased rate of 9.5 cents to reflect the cost of a $20 million airport revenue bond issue. United has been paying the increased fee under protest. Its present contract has three more years to run.

One of the carrier's basic objections to the increase, aside from the fact that the fee is now being leveled on the basis of far higher gross landing weights and increased flight schedules, is that the city would realize an earned reserve of $30 million over the next 27 years, above and beyond the cost of operating the airport. The airline argues that this reserve fund is too high and will end up in the city's general budget fund, rather than being used to lower the airline costs at Stapleton.

The city's reply is that only $12 million of the authorized bonds have been issued and that terms of the bond issue clearly state that any reserve earned in excess of actual need can only be used to retire bonds in advance of their maturity date, or to install new capital improvements at the airport. Twenty-five years ago no one could foresee the need for jet runways, the city contends, noting that it would seem naive to assume no further capital improvements will be needed over the next 25 years.

Comparing the cooperation of other municipalities on its system, United stated that it and other airlines had signed a long-term contract with Chicago for the operation of O'Hare Field under which all revenues are returned to the airport under a formula resulting in lower landing fees, hangar and counter rental charges for the airlines. This was achieved by underwriting of a $120-million bond issue by the carriers using O'Hare. Denver countered that this arrangement cost Chicago a higher interest rate than Denver, and that the original cost for the first stage of O'Hare development is now almost $35 million above original estimates. In addition, the city claimed there is a current need for an extra $26 million for new items not originally contemplated in the O'Hare budget.

Faced with the prospect of a flurry of airport contract changes, the industry through the Air Transport Assn. has had a report on this problem prepared by the Stanford Research Institute of South Pasadena, Calif. The report is understood to have made a thorough survey of the complex formulas now in use, with those suggested means of meeting the problem.

- **Pricing of airport services should reflect the difference between primary and secondary airport functions and the operating characteristics of specific users.**
- **Airports should be recognized** as separate entities for management purposes.
- **Airlines, since they produce the market for other airport revenue,** should bear only the costs that cannot be recovered in other ways.
- **Communities should decide** whether their airline service is valuable enough to justify the subsidy necessary to operate the airport.
- **Best method of financing** airport development appears to be the issuance of general obligation bonds, requiring airport revenue to be earmarked for bond retirement.
- **Uniform system of accounts** for airport operators could be instituted by FAA under existing legislation, and would make it possible to achieve a realistic comparison of costs and income.
- **Failure of airport operators** to charge reasonable fees and thus avoid continued disagreements with airlines could lead to government price fixing.

BOAC Trims VC.10 Order

London—British Overseas Airways Corp. last week formally signed its VC.10 jet transport contract with Vickers-Armstrongs, cutting three standard VC.10s from its order for 15.

As it stands, the contract calls for delivery of 30 Super VC.10s and 12 standard VC.10s. The move now puts the Vickers order book at 54. Other customers are Royal Air Force, five (AW Sept. 11, p. 37), Ghana Airways, three, and British United Airways, four.

The possibility that the BOAC order might change was hinted earlier this year in the airline's annual report, when Chairman Sir Matthew Slattery mentioned that re-equipment plans would be subject to British Treasury review. The airline also has predicted a heavy deficit for Fiscal 1961 operations (AW Dec. 18, p. 50).

The order also involves complying with the Chancellor of the Exchequer's edict on capital investment limitations by nationalized corporations. In BOAC's case, the VC.10 order, with engines and spares amounts to $423 million.

Negotiations started Jan. 14, 1958, when BOAC ordered 35 standard VC.10s with an option for 20 more, but the order was revised in June 1960 to order 10 Super VC.10s, an airplane 28 ft. longer.

When this airplane was revised downward to the present 171 ft. 8 in. length, BOAC decided to switch its order to 30 Supers and 15 standards. The latter airplane is 158 ft. long. The airline feels that with 30 Supers and 12 standards, the airplanes can be more fully utilized in the BOAC world-wide network.

The standard VC.10 can carry a maximum of 150 passengers and the Super VC.10 can carry 180 in economy class. Capacity in mixed class is 135 passengers for the standard and 163 for the Super. Design payload for the standard is 38,000 lb., against 45,000 lb. for the Super.

Franco Government Asks Entire Iberia Air Lines Board to Resign

By L. L. Doty

Franco government has asked for the resignation of the entire board of directors of Iberia Air Lines of Spain, AVIATION WEEK has learned

The changes, which have been expected for some time (AW July 3, p 34), were precipitated by Instituto Nacional de Industrias (INI) the agency which owns the state-operated airline

Indications are that Tomas Delgado Perez de Alba, board chairman and president of the airline and one-time president of the International Air Transport Assn., is included in the shakeup Cesar Gomez Lucia, Iberia director and general manager and one of Spain's most knowledgeable airline veterans also has moved out of his post He had been anxious to retire during the past year

No other management officers have been affected by the government move Key to the future of Iberia lies in the replacement of Gomez Some observers close to the Iberia situation have long feared that INI will fill the general management position—the top operating post in Iberia's management structure—with either a high ranking air force officer or a person entitled to political patronage

Such a move would leave the airline in its present state of slow progress and development It would certainly continue to suppress the small core of managerial talent that has achieved some success in attaining recognition in international air transportation for Iberia, despite handicaps imposed upon it by the former board

On the other hand, many observers are interpreting the INI move as indicating that the government is now ready to inject new life in the carrier by providing it with a strong and experienced top management leader and a board of directors more sympathetic to the airline's requirements than the previous board is said to have been

The latter group has been charged with hampering Iberia's growth through stringent sometimes miserly control of expenditures that has blocked the development of an adequate re-equipment program and an effective sales and promotional plan It is highly possible that, if the government upgrades any of Iberia's experienced officers now on the company roster to the top position, Iberia may emerge as a new competitive threat on international routes

In the past, Iberia has been allowed to flounder without a firm goal because of a split opinion as to where its major market lies One faction insists that the airline should develop its strength on the lucrative North Atlantic route, while opponents hold that the carrier's natural market belongs in Spanish speaking Latin American countries This group also feels that the North Atlantic route should be served with a perfunctory schedule for diplomatic purposes only

This split has never been resolved by the board of directors and, as a result Iberia's small fleet of aircraft has been thinly spread to serve both markets so that neither has been provided with a competitive frequency of service

INI took the initiative in providing Iberia with its Douglas DC 8 turbofan transports, an indication that it has stronger interest in developing Iberia than is generally believed If this is true it is very possible that it has dropped Iberia's board of directors because of a failure to allow the airline to progress normally Not to be overlooked, however, is the fact that board positions carry substantial prestige are sought after and are controlled by a government always willing to grant favors to its benefactors

The airline has also been hindered by the lack of funds to exploit major U S markets The U S sales staff is efficient and productive but it operates without proper sales tools Advertising budgets are small and because of the limited size of sales staffs proper geographic distribution of sales efforts is not possible A group within Iberia's management has long striven to correct this deficiency, without any success

Meanwhile Iberia has lagged in the development of traffic on the North Atlantic route with TWA sole U S carrier serving Madrid capturing the lion's share of business to and from Spain

Most Airlines Seek New Fare Increase

Washington—Trunkline carriers filed tariffs for a general 3% fare increase last week in the wake of a Civil Aeronautics Board decision rejecting a variety of higher increase proposals in favor of the slight rise (AW Jan 1 p 27)

By the middle of the week all 11 trunklines plus North Central, Mohawk and Frontier Airlines had filed for the increase effective Feb 1 and the balance of local service airlines were expected to follow

While significantly short of the proposed fare increases which ranged well above 5%, the raise suggested by CAB was quickly accepted and brought the total fare increase granted since 1958 to almost 30% The increase will be permitted for six months during which CAB will examine other means of improving the industry's financial status

Although dissatisfied with the increase, since it is not only smaller than requested but in its across-the-board form it fails to narrow the revenue gap between first-class and coach services, airlines generally conceded the increase will probably improve earnings without affecting traffic growth

On this assumption, Continental Air Lines estimated the increase will raise its revenues an estimated $1 million during the six-month period United estimated earnings would increase by $13.5 million annually American, $11 million, Eastern, $8 million, Trans World Airlines $7 5 million Delta $5 million and Braniff, $2 million

Tokyo Flight to Begin Swissair 990 Service

Geneva—Swissair plans to inaugurate scheduled service with its Convair 990 Coronado medium range jet transports on Mar 9 with a flight over its Far Eastern route to Tokyo

At the time four of five 990s Swissair plans to operate will be on hand, with the fifth scheduled to arrive in July Two other Swissair-owned 990s to be leased to Scandinavian Airlines System are due to be delivered in February and March and SAS probably will begin service with them on its southern route to Japan later in the spring

Final details of the formal contract for the purchase of the aircraft and the lease of the two to SAS were still being negotiated last week

With the 990s in operation, Swissair will return to Convair the two 880 transports it leased last fall, following a delay in Coronado deliveries in order to meet the jet competition of airlines on the Far Eastern run The first aircraft is expected to be returned in March the second in April

Swissair also will use its five aircraft on schedules to South America and the Middle East

Meanwhile, SAS Interim President Curt Nicholin apparently has agreed to extend his tenure with the airline in order to complete his reorganization plan The reorganization is an effort to bolster the carrier's sliding financial fortunes, a chore, according to one official, "that is considerably more complicated than anyone anticipated" Nicholin, a Swedish electronics executive who stepped in on a temporary basis last summer originally had planned to leave at the end of the year

General Concept of Sikorsky S-65 Envisioned

Artist's drawing shows the general concept for the Sikorsky S-65, which is being proposed to airlines as a 60 passenger, 150 kt. transport for short hauls (AW Nov 6, p 41) The aircraft is basically the Sikorsky S-64 flying crane dynamic components and engines—Pratt & Whitney JFTD12s—with a passenger cabin Sikorsky is building two S-64s for West Germany (AW Dec 25, p 38).

Airline Defers Helicopter Order; Blames FAA Rule, Traffic Drop

Washington—Chicago Helicopter Airways last week told the Civil Aeronautics Board it would defer its order for four Sikorsky S 61L helicopters for at least six months because of a decline in traffic and new Federal Aviation Agency operating restrictions

Should CHA decide to purchase the helicopters later however the contract with Sikorsky will require renegotiation since actual sale was contingent upon the airline getting a loan guarantee from the CAB before Dec 31 The loan guarantee had not been approved as of that date

C W Moore, CHA executive vice president told the Board that the recent shift in airline operations from Chicago's Midway Airport to O'Hare Field has affected the level of passenger traffic With the virtual phase out of scheduled at Midway, demand for helicopter service between Midway and the Chicago Loop and between Midway and O'Hare has dropped sharply severely disrupting the triangular traffic pattern that gave the carrier its earlier spectacular growth

Moore also said that new FAA regulations pertaining to twin turbine helicopters affect their utility in scheduled airline helicopter service He apparently was referring to interim procedures which call for raising standards for the determination of acceptable emergency landing sites for multi-turbine helicopters

To meet these standards in the Chicago area would require a costly capital outlay, according to Moore New York Airways feels that it is properly equipped with adequate emergency landing sites, according to its interpretation of the new procedures

CHA will continue to operate its fleet of single-engine S 58 helicopters on the route Moore emphasized that the airline is not deferring the order because of dissatisfaction with the performance of the S 61

Youth Fares Failed To Generate Traffic

Washington—Initial reports to Civil Aeronautics Board by domestic trunklines indicate that the experimental youth fare plan failed to generate new traffic and may have caused some diversion from first-class and tourist categories

United Air Lines, for example estimates that youth fares accounted for 2 47% of all traffic handled between Sept 1 and Nov 17 If this traffic was diverted from regular classes United reported, the loss to the airline was $1 19 million

TWA conducted a small survey which disclosed that 63% of youth fare passengers was actually diverted from other fare classes However the airline found that there was no material effect on over-all revenues as a result of the youth fares, but that a $20 000 increase in expenses was incurred through handling costs of the experimental fare Net result was a slight loss

Delta Air Lines reported that it was not certain what actual effect the youth fares had on traffic diversion or on gross revenues But the airline concluded that the youth fare failed to stimulate any new traffic Traffic growth rate during the period the youth fares were in effect was less than the 11 month growth rate of 9 5% recorded in 1961

Delta said it was not possible to determine the effect the youth fare had on no-shows, but felt that a substantial increase in late cancellations was attributable to the youth fare passenger

National Airlines said that 1 92% of all traffic was youth fare passengers

Youth fares went into effect Sept 1 remained in effect until mid November on some airlines and until the end of November on others

Eastern Asks CAB For Air Shuttle Extension

New York—Eastern Air Lines has filed for an extension of its "air shuttle" service with CAB to provide Boston Washington nonstop flights beginning Feb 1 The low fare, no reservation guaranteed seat service now operates between New York and Boston and New York and Washington

The Boston-Washington flights will be scheduled on a five a day basis during business days They will depart both terminals at 7 30 and 11 30 a.m. and 2 30 5 30 and 8 30 p m As with the present service standby piston equipment will be used to assure all passengers a seat

Northeast, Hughes Tool and Atlas Agree on Financial Aid Program

By Ward Wright

Washington—Northeast Airlines, Hughes Tool Co. and Atlas Corp., owner of a 56% controlling interest in the airline, have agreed on a financial program designed to save Northeast from possible bankruptcy.

Northeast revealed the program after several months of trying to find a way out of its financial troubles (AW Dec. 4, 1961, p. 39). Before the agreement can become effective, Northeast must first persuade creditors who financed its aircraft and its major suppliers to postpone demands for payment on past due debts. Hughes Tool then must approve these arrangements.

The agreement, subject to Civil Aeronautics Board approval after all parties agree with arrangements, calls for:

- **Hughes Tool to acquire** the 996,000 shares of common stock and the $16 million subordinated notes Atlas holds in Northeast. Cost to Hughes Tool will be $5 million cash payable within 30 days of CAB approval.
- **Hughes Tool to use** its "best efforts" to provide or obtain sufficient funds to ensure Northeast's financial integrity.
- **Cancellation by Hughes Tool** and Atlas of interest payments that would have come due during 1961 and 1962 on previous loans. The move will save Northeast $1.2 million in 1961 interest payments and $1.5 million for 1962.
- **Interim financial assistance.** Hughes Tool has agreed to give Northeast as much as $1 million to enable the carrier to operate full schedule throughout the winter season. Such assistance already has CAB approval pending the outcome of the Northeast Control Case (AW Dec. 11, p. 41).

Meanwhile, Eastern Air Lines last week was awaiting CAB action on Eastern's request for permission to cross-examine Howard R. Hughes concerning his intention to gain control of Northeast through Hughes Tool Co.

Eastern asked CAB to subpoena and issue an order of deposition to compel Hughes to answer under oath before an appropriate CAB officer in Washington on Jan. 16 any questions it might ask concerning Hughes' relations with Northeast. Eastern acted under a CAB rule of practice authorizing such a procedure if proper application is made and it is for good cause.

Eastern said that it wanted to quiz Hughes before the CAB launches a full-scale evidentiary hearing on whether it would be in the public interest for Hughes Tool to control Northeast. The examination of Hughes would prevent the possibility of Eastern being taken by surprise if Hughes later testifies at a formal hearing, Eastern said.

Eastern listed 23 questions it wanted to put to Hughes about his or Hughes Tool's actions. Some of the areas Eastern wants to explore are:

- **What control would Hughes** or the firm exercise over Northeast?
- **What considerations would Hughes** or Hughes Tool have for Northeast's minority stockholders?
- **What control has Hughes** or Hughes Tool had over Northeast in the past?
- **What are Hughes' or Hughes Tool's** intentions toward Northeast in the event CAB does not renew all or part of its Florida routes? Hearing on the renewal of Northeast's Florida routes is slated for Jan. 9 at CAB.

Eastern said it was reluctantly filing its application for subpoena and cross-examination of Hughes in accordance with regular Board practice. Eastern said it would have preferred to file the petition privately with the Board to avoid publicity. Eastern said it was apprehensive that the publicity would cause Hughes to attempt to be unavailable for the hearing.

Under an order of deposition, Hughes would be cross-examined by Eastern in the presence of a CAB officer for the record. Any objections raised during the proceeding would merely be noted in the record and the CAB officer would not be allowed to rule on them. When the proceeding ended the witness would be asked to sign the record. If he failed to do so, it would be entered together with the reason in the record.

Northeast told the CAB last November that it had to have financial help or face bankruptcy (AW Nov. 27, p. 37). Northeast said Hughes Tool, wholly owned by Howard Hughes, was the only potential lender. Eastern has been strongly opposed to any Hughes Tool effort to aid Northeast.

In other action in the Hughes Tool-Northeast Control Case, Northeast, Delta Air Lines and National Airlines objected to parts of a CAB Bureau Counsel motion to expedite the case.

Bureau Counsel had asked CAB to set an immediate hearing date for the control case and requested that the Jan. 9 hearing date in the New York-Florida Renewal Case be allowed to stand. Counsel recommended that the two cases be heard separately. Counsel added that if a need for three carriers in the Northeastern U.S.-Florida market is shown in the renewal case, then selection of carriers should be left until the outcome of the control case, because of questions concerning Northeast's willingness and ability to operate the route.

Northeast said it opposed any attempt to separate the need phase of the renewal case from the selection of carriers, because need could not be determined without consideration of related issues. Northeast named one-carrier service from points on its New England routes to Florida and the future of New England regional air service as related issues. Northeast said it was not opposed to expediting the control case.

Delta and National objected to the Bureau Counsel proposal to conduct the control and renewal hearings concurrently as an "unfair burden on the parties." Both airlines asked that the control case be expedited and settled before continuing with the renewal case.

Trident Flight Delayed

London—Freezing weather last week indefinitely delayed first flight of the de Havilland Trident three jet transport.

The aircraft had been ready to fly during the holiday season, but heavy snows which blanketed the United Kingdom put 12 in. of snow on the company's Hatfield runways. Decision last week was to wait for a thaw, rather than clear the runway and accept the hazard of ice sheeting.

Howard Hughes Sued by Attorney

Los Angeles—Legal action has been initiated here against Howard Hughes by one of his former attorneys, Frank J. Waters, who alleges that Hughes owes him $1,094,250 in legal fees.

A similar complaint for a like amount filed Dec. 23, 1960, on behalf of former Hughes' attorney James J. Arditto (AW Jan. 2, 1961, p. 33) was settled out of court.

Wording of the complaint filed by the Los Angeles law firm of Crowley and Rhoden on behalf of Waters is almost identical to that of the previous suit, according to Arthur J. Crowley.

In the complaint, Hughes is named personally along with the Hughes Tool Co., Hughes Aircraft Co., and the Howard Hughes Medical Institute. The latter two organizations are named because Waters alleges in his complaint that Howard Hughes controls the aircraft company through the medical institute.

Soviets Deliver Turboprop An-12 to Ghana Airways

First Soviet An-12 turboprop transport for Ghana Airways is shown during a ferry stop at London's Gatwick Airport. The aircraft is a military version of the An-10A transport, with a completely redesigned aft section to provide a rear loading door and tail gunner's position. Instead of armament, the tail gunner's position in this aircraft was equipped with a toilet. Bomber type nose of the An-10A is retained on the An-12. Powerplants probably are the same as the civil version—four Ivchenko AI-20 turboprops of about 4,000 ehp.

Long Island Property Owners Ask Idlewild Property Damages

New York—Large group of property owners in Rosedale, Queens, Long Island, has gone to court to ask damages from airlines serving Idlewild and from the Port of New York Authority, operator of the airport.

The plaintiffs, numbering 809 persons, are seeking a judgment against 40 scheduled and non-scheduled airlines of a sum equal to 20% of the rental value of their homes, claiming loss in value because of aircraft noise and danger. Judgment against the Port Authority for 20% of the rental value and 20% of the fair market value of the properties is sought.

The complaint was filed in the Supreme Court of the State of New York, County of Queens.

The plaintiffs allege that their residential properties have been damaged by the wrongful acts of defendants and will sell, if at all, for only 80% of their fair market value. Rental value has been damaged by at least 20%, it is claimed by the plaintiffs.

The judgment for rental value would cover the period from the inception of flights to date of trial of the suit. Regarding the airline defendants, the complaint states that the plaintiffs are in doubt as to the liability of each defendant and the extent of redress due from each may be determined between them upon trial of the action. Judgment is asked against all of the airline defendants, or an apportionment by the court between the defendants, jointly or severally, of the damages suffered by each plaintiff. The suit also seeks to recover court costs and "other and further relief as the court may deem just and equitable."

Idlewild Flights

About 26,000 flights per month of commercial aircraft, jet and non-jet, take place in and out of Idlewild, the complaint states. Aircraft prior to takeoff warm up the jet motors or propeller motors "by turning over such motors at a tremendous rate of speed and do then make such tremendous noises that it interferes with the use and enjoyment of the plaintiffs' properties by making ordinary conversation difficult and often absolutely impossible." In taking off and landing, the complaint charges, aircraft fly at heights of less than 500 ft. and often as low as 100 ft. while close to the plaintiffs' properties. While the aircraft are near, it is charged, the motors are so loud they deprive plaintiffs of the use and quiet enjoyment of their property and the vibrations shake and rattle doors, windows and dishes and make normal conversation and use of television and telephones impossible. Plaintiffs and their families allegedly "suffer great mental stress and fear" while aircraft are over their property. The flights often are "a danger to the health and welfare" of the plaintiffs. This includes loss of sleep at night.

Federal Housing Administration will not insure loans on their property, the plaintiffs charge, furthering the value loss and making resale difficult and often impossible. In the past three years, operations have increased, airplanes are larger and noisier, and the advent of jets in 1958 greatly increased the problem, it is charged.

Approach Area

The complaint charges that the Port Authority, in conducting an airport where it did not own the approach area, has appropriated to its own use the property as an approach area without payment or compensation. The agency, it is alleged, has the power to acquire the property by condemnation but has failed to do so and/or has refused compensation.

A number of cases in which residents of airport areas have sued for damages against aircraft noise effects or for injunctions against operations have been instituted in recent years.

One case originating in Allegheny County, Pa., now is before the Supreme Court of the U. S. A surviving plaintiff, a property owner near the Greater Pittsburgh Airport operated by the county, is seeking compensation from the county for alleged damage to his property because of aircraft operations. Courts so far have held that his claim should be against the alleged trespassers—i.e., the aircraft operators—rather than the county.

Another recent suit was brought against the Port of Seattle by a group of owners of property near Seattle-Tacoma Airport. Originally there were 94 plaintiffs in this damage suit resulting from aircraft noise, but the number had dwindled to 24 by the time the suit was dismissed—in June, 1960—by superior court. No further appeal has yet been taken. Among the court's grounds for dismissing the suit were the fact that the property was about to be condemned by the port and therefore was not subject to damage suits, and that the statute of limitations had expired because the noise and inconvenience had existed for more than three years prior to the action.

In the New York area, previous actions involving aircraft noise and hazard have been brought by the town of Cedarhurst, also near Idlewild, and by a mayors' committee of communities near Newark Airport. In the Cedarhurst case the town passed an ordinance restricting aircraft operation over the town's airspace. Lower courts held the ordinance illegal and it never went to the Supreme Court. The mayors' committee sought an injunction restricting operations at Newark, but the court did not grant it.

Observers felt that in the Rosedale case a major issue would be the possible proof or lack of proof of whether property values actually have been affected adversely.

Specific Instances

According to some observers, plaintiffs in such cases have encountered difficulty in pinpointing specific instances of damage and identifying them with a particular defendant. In the Newark case, for example, plaintiffs claimed specifically that their television enjoyment had been interfered with on certain occasions by disruption of picture as well as noise. But, by not being able to specify the airline involved, they could not reduce the incident to one defendant.

It was also felt that such groups need expert technical advice in preparing their case to reflect specific damage, advice not easily available to them.

Because of the number of defendants in the Rosedale case, it is possible that as long as a year may elapse before the case comes to trial, with considerable time being consumed in pre-trial hearings.

KLM Subsidy

The Hague—KLM Royal Dutch Airlines, which estimates its 1961 losses at between $19.4 million and $22.2 million, is formally applying for government subsidy to help it overcome present difficulties and complete projected equipment orders.

An airline spokesman said last week that the government has been handed a memorandum in which the company's position has been stated and in which requests have been made to improve future financial status. Actual contents of the memorandum have not been disclosed.

Later in the week, however, the Dutch minister of transport said that KLM and other carriers must find means of cooperating more closely "even if it means a loss, more or less, of individual autonomy."

KLM, which has remained outside the European Air Union consortium, has negotiated in the past over the possibility of joining the independent grouping of Swissair and Scandinavian Airlines System.

Basle Airport Growth Contingent on Funds

By Edith Walford

Basle—Authorities of Basle-Mulhausen Airport, terminal point for a Swiss city and located entirely in France, hope to receive local Swiss government approval early next year for a revised modernization and expansion plan for present facilities.

An earlier proposal calling for the expenditure of about $18.75 million for the construction of a five-floor concrete terminal building, longer runways and badly needed additional maintenance and overhaul workshops, was voted down by a bare majority in a public Basle cantonal referendum in June of last year.

Reducing the funds required to approximately $13.5 million, the revised proposal involves a less elaborate, four-floor building, fewer aprons and excludes any extension of the two existing 7,774-ft. and 5,248-ft. concrete runways completed in 1949.

Defeat of the measure would mean that Basle Airport will remain confined primarily to European tourist flights and charter carrier services, of which the latter accounts for at least 50% of all present traffic at the airport. It earlier had hoped to join Zurich and Geneva as an intercontinental traffic center in Switzerland capable of accommodating large, heavy turbojet aircraft in addition to the long-haul piston-engine transports already serving Basle.

Smallest of Three

As the smallest of Switzerland's three major airports, Basle has long been hampered by lack of funds to cater to the requirements of intercontinental jet services. With only one hangar for up to six piston aircraft, it is inadequately equipped for any extensive maintenance and overhaul work. In addition, the large turbojets can use its present runways only when, with a minimum load of passengers and a minimum load of fuel, they are on the last leg of any flight via Basle to Zurich or Geneva.

Yet a comparison of the figures reflecting the airport's growth in terms of passengers and cargo handled during the last 10 years provides a strong case in favor of more investment in its development. For example, with 19,033 passengers, 375 tons of freight and 492 tons of mail handled at Basle in 1950, all categories of traffic have increased steadily from year to year until, by the end of 1960, they amounted to 314,353 passengers, 1,774 tons of cargo and 7,603 tons of mail handled.

An unprecedented feature of the airport at Basle is that it is located on French soil although financed and run by a half French, half Swiss international company. Swiss share is 70% Basle canton-owned, the rest financed by the Swiss government.

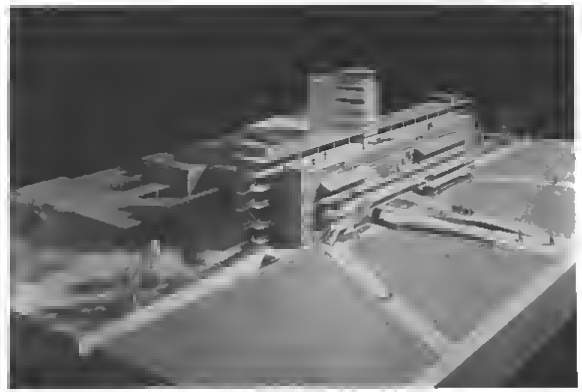
Double Interests

Prior to World War 2, both countries concerned had realized the need to establish a future international airport to serve the interests of both France and Switzerland. The war intervened, however, and was followed by long, complicated negotiations until the basic problems involved could be resolved.

In order to avoid losing a potential share of air traffic which increased rapidly during the post-war period, it was obvious that Basle must have an airport immediately. Therefore, based

BOEING 707 turbojet transport of South African Airways lands at Basle Airport on the last stage of its intercontinental flight into Zurich.

LOCATED ON FRENCH SOIL on the northern frontier of Switzerland, Basle Airport is run jointly by an international company consisting of half French, half Swiss nationals. The airport's two present concrete 7,774-ft. and 5,248-ft. runways serve the operations of both countries. In other respects there are separate Swiss and French traffic handling installations.



APPROXIMATE LAYOUT of the terminal building and aprons at Basle Airport, as envisaged in the original reconstruction and expansion program, rejected by a majority of 500 in a public vote in June last year, is pictured above. A revised proposal covering a less elaborate building and aprons and calling for an expenditure of about $13.5 million instead of $18.75 million originally requested, will be the subject of a second cantonal referendum next spring.

only on mutual verbal consent rather than on official agreement between the two countries, funds were jointly provided for the construction between March and May, 1946, of temporary buildings and all the other essential facilities.

Commercial Airport Use

These were installed on the land previously earmarked and given by France for commercial airport use.

A formal state agreement concerning the future final construction and administration of the airport was signed by the two countries in July, 1949. It stipulated that the airport was being built on land provided free of charge by France.

In exchange for this, Switzerland undertook to assume the cost of the initial airport installations. The agreement also assured Switzerland the same commercial air traffic rights at Basle it would enjoy at an airport located on Swiss territory.

To ensure the free passage of people or cargo from Switzerland to the airport, construction was started in 1949 of a control-free customs road. Leading from the outskirts of Basle as a neutral-zone approach road to the airport, it is separated by a high, wire-net fence on either side from the rest of the French terrain through which it runs.

Future Problems

The airport agreement signed in 1949 could not foresee the many additional future problems destined to arise with rapidly changing conditions in the air transport business as a whole. Soon, further prolonged negotiations became necessary and it was only after their completion in 1953, that the originally envisaged joint Swiss-French exploitation of Basle Airport began.

Basle Airport's Traffic Growth

(1950—1960)

	Passengers handled	Freight in tons	Mail in tons
1950	19 033	375	492
1951	22,700	401	987
1952	26,849	334	898
1953	77 325	407	1,853
1954	67,776	484	1,474
1955	96 421	828	2 208
1956	121,638	552	2,643
1957	191,657	844	3,412
1958	298 777	1 830	5,090
1959	312,969	1,541	6,831
1960	314,351	1,774	7,603

TCA Passenger Total, Seat Miles Increase

Trans Canada Airlines' passenger total increased 7.6% last year over 1960 to 3,700,000, and revenue passenger miles rose 21% to about 2.5 billion. Available seat miles were up 25% to 3.9 billion during 1961, and load factor was 64%, down 2% from 1960.

The Canadian carrier introduced a new fare structure last year (AW Jan. 9, 1961, p. 42) involving a cost curve principle of fare setting. Under the new system, average return per passenger mile in 1961 was 5.8 cents compared with 6.25 cents in 1960.

Revenue miles flown by TCA declined 8% in 1961 to 52,724,000, reflecting replacement of piston aircraft by larger jets and turboprops. Revenue ton miles increased 18.5% to 276 million. Available ton miles were up 29% to 521 million.

'Wrong Field' Landing Re-checked by FAA

New York—Federal Aviation Agency last week was re-checking the Eastern Air Lines DC-7B captain whose aircraft recently touched down by mistake at Mitchel AFB after being cleared for landing at Idlewild. No FAA disciplinary action had been determined by last Wednesday.

Copilot Kenneth L. Dean was at the controls of the Montreal-New York flight with 50 passengers and a crew of five aboard when it went into the abandoned Air Force field. Captain Richard H. Hamman took over before the aircraft stopped rolling, took off again and landed at Idlewild a couple of minutes ahead of schedule.

The flight had canceled its IFR plan, gone over to tower control, and had reported on the left base leg of Runway 25 at Idlewild. A TWA aircraft calling for landing clearance, was advised of the Eastern flight as traffic, but replied he couldn't see it. The TWA flight then was cleared to make its landing.

Shortly thereafter, the Eastern flight called to report its position as southwest of Mitchel.

Visibility was 5 mi., with some haze and snow on the ground. According to FAA, the copilot said he had passed Grumman Field on the way into Idlewild and didn't realize Mitchel was there.

No formal action is planned against the copilot, who was permitted to resume flying under certain restrictions after the FAA hearing was completed. The captain was taken off scheduled flights temporarily and is being given Air Transport Rating checks by FAA.

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Three basic methods lie at the heart of this program: Investor's Method (Rate of Return on Investment), Average Annual Return on Investment, and Payout Period. Use the method that best meets your requirements—the computer prints out the probable results of each proposal, gives you a uniform, accurate guide to sound investment.

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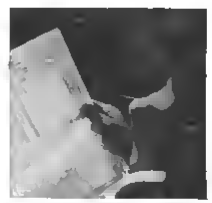
■ *Which line of research?* This requires knowledge of all the facts. CIP provides a uniform guide to help you make the right decision.



■ *Make or buy?* CIP helps you correlate all the facts such as materials availability, effect on taxes. Decisions come quicker, easier.

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AIRLINE OBSERVER

► Watch for Federal Aviation Agency, probably during the next session of Congress, to urge legislation that, in effect, will establish new criteria for measuring how much use airlines, general aviation, the private aircraft operator and the military services derive from the air traffic control system. Both Congress and the White House have expressed concern that the current 10% tax on airline tickets and the excise tax on aviation fuels are not returning a sufficient percentage of ATC's annual operational costs.

► Forecasts for trunkline activity in 1962 call for an upturn in business. United Air Lines predicts a 10% increase in passenger traffic. Donald W. Nyrop, president of Northwest Airlines, forecasts a "small but welcome" increase of 5%. A 6% increase in domestic traffic is the forecast of Charles C. Tillinghast, TWA president. American Airlines predicts a 10% traffic rise in 1962 which, it says, "would represent an above-normal growth rate as a recovery from the failure to grow normally in the previous two years." American's forecast is based on the prediction that domestic trunkline passenger traffic will rise at a faster rate than the general economy, which, American says, is likely to be 5 to 6% above the average for 1961. The sudden upswing in traffic volume during the latter part of 1961's final quarter has generated new optimism within the industry.

► Appointment of a ranking Air Force officer to succeed James T. Pyle, who resigned as deputy administrator of Federal Aviation Agency on Nov. 3 (AW Oct. 16, p. 43), now is considered a strong possibility. FAA Administrator Najeeb E. Halaby's efforts to find a top-notch civilian deputy have been stymied by industry salary levels and a conflict of interest statute that will force the appointee to divest himself of all aerospace stock holdings.

► Iraqi Airways has contracted to provide ground service at Baghdad for Alitalia, Swissair, Saudi Arabian Airways and Iranian Airways beginning this month. Similar services will be provided Pan American, KLM and Lufthansa beginning Apr. 1.

► U. S. scheduled airlines' 1961 safety record was their third best in history. Record of .30 fatalities per 100 million passenger miles last year was surpassed only by the .07 rate in 1954 and .20 in 1957. A total of 122 passengers died in three crashes during 1961.

► Chamber of Commerce of the United States has urged the Kennedy Administration to issue an Executive Order that would direct the Commerce Secretary to establish a unified policy for all transportation activities. The group claims that lack of coordination has produced such inconsistencies as the Civil Aeronautics Board granting subsidies to local service carriers on routes over which Interstate Commerce Commission has authorized discontinuance of rail service.

► Russia claims its An-14 "Pchelka" (Bee) transport (AW Nov. 13, p. 45) can carry six passengers and their luggage on a 125-155 mi. flight. It is powered by two AI-14R 260 hp. radial engines using V-530 variable-pitch propellers. Span is 65 ft., length 36 ft., height 13.7 ft., wing area 469 sq. ft., empty weight 4,400 lb., weight in flight 6,600-7,040 lb., maximum speed 155 mph., cruising speed 125 mph., landing speed 41.5 mph., ceiling 16,400 ft., range 620 mi., rate of climb 6,560 ft. in 10 min., landing distance 131-164 ft., takeoff distance 197 ft.

► Independent Airlines Assn. has protested the Defense Department's order barring individual servicemen from buying tickets on supplemental airlines. In a telegram to Defense Secretary McNamara, the association said there were no legal, factual or moral reasons why its member airlines should be restrained from selling tickets to military personnel.

► United Air Lines last week charged that the Civil Aeronautics Board decided to increase competition on the Atlanta-Toronto route on the same day that CAB Chairman Alan S. Boyd blamed excessive competition for the industry's financial problems. In a petition for reconsideration, United said that granting the route to Eastern Air Lines was in "... complete repudiation of the Chairman's expressed hope that the Board has learned enough not to create excessive and costly competition."

SHORTLINES

American Airlines is to take delivery of its first Convair 990 jet transport early this month. A second will be delivered a few days after the first. The first aircraft will go into immediate use for pilot training and the second will be used for a proving flight after slight modifications at Tulsa maintenance base.

► Delta Air Lines is offering six package winter fishing vacations in Florida and the Bahamas in the $57.50 to $160.37 price range, plus air fare.

► Irish Airlines has contracted with American Airlines for 2,500-hr. overhaul of two 720 jet transports at American's Tulsa maintenance base. Overhaul time will be about two weeks per aircraft.

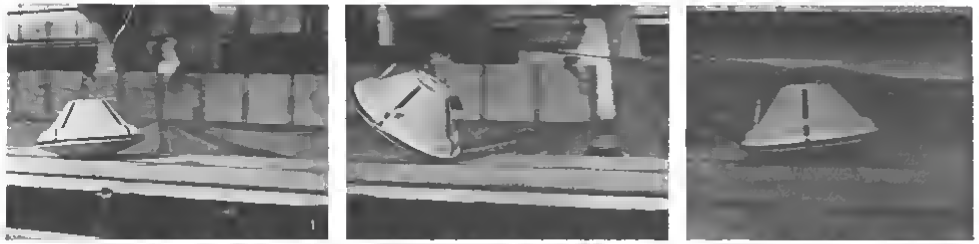
► New York Port Authority reports that passengers in the New York-New Jersey metropolitan area have a choice of 484 nonstop flights weekly to Washington and 459 flights weekly to Boston. Figures represent flights available at La Guardia, Newark and New York International airports.

► Ozark Air Lines has turned over the first of four Convair 240 transports it acquired from Lufthansa to American Airlines' Tulsa maintenance base to determine the extent of modification required for Ozark's needs. Changes contemplated include installation of air-stair doors, radar equipment, carry-on luggage racks and regrouping of flight instruments to approximate configuration used on Ozark's Fairchild F-27s.

► Sikorsky S-61L twin turbine helicopter will enter scheduled passenger service this month with time between overhaul (TBO) intervals of 1,000 hr. for following components: engine, main gear box, main rotor head and tail rotor hub. Intermediate and tail gear boxes will have a 3,000 hr. TBO. Los Angeles Airways will begin operating the helicopters this month and Chicago Helicopter Airways will begin later in the year.

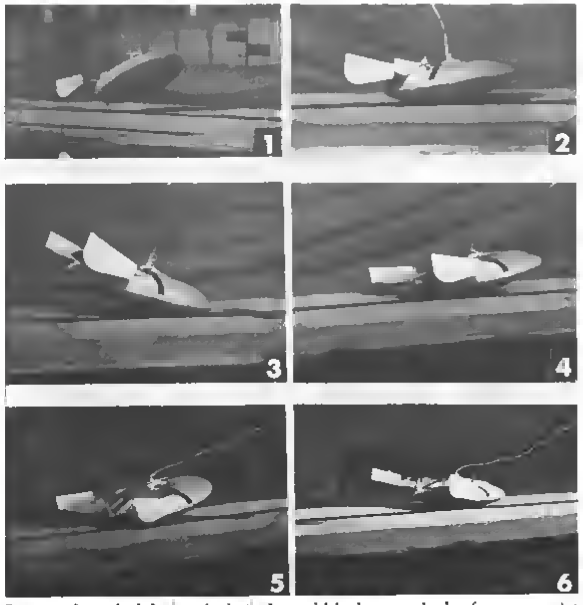
► TAI, privately owned French Pacific airline, has adopted reduced fares for its circle route itinerary originating in Los Angeles. New first class fare is $1,761, compared with $1,800, and new tourist rate is $1,131, compared with $1,216. The circle route permits travelers to visit as many as 25 cities in Australasia, the South Pacific area and the Far East.

► Alitalia reports inauguration of twice weekly round trip DC-8 jet service on its Rome, Accra, Ghana and Lagos, Nigeria route.



Re-entry vehicle model with a spheroidal-shaped bottom used as a skid-rocker in impact studies at Langley Research Center. Landing is made with an 80 fps horizontal velocity, and low vertical velocity. Friction, aerodynamic damping and curvature of bottom regulate acceleration.

Skipping action for vehicles with spheroidal shaped bottoms was less in Langley tests than that for longitudinally-curved and flat bottom vehicles.



Sequence shows the behavior of a lenticular model landing on a hard-surface runway at a horizontal velocity of 150 fps. This skid-rocker landing is controlled by deployable tail panels

NASA Impact Studies Evaluate Landing Systems for Spacecraft

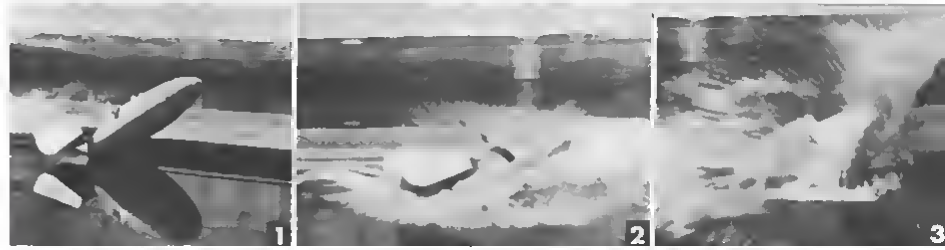
Vertical velocity reduction is considered much more a problem than dissipating horizontal velocity in landing systems for manned re-entry vehicles, according to research being conducted by the National Aeronautics and Space Administration.

This conclusion comes from a series of water, concrete and sand impact studies at NASA's Langley Research Center which are designed to evaluate landing impact dissipation systems. Studies have used a variety of generalized research configurations (see photos) which indicate that dynamic models can be valid research tools in assessing operational systems and configurations.

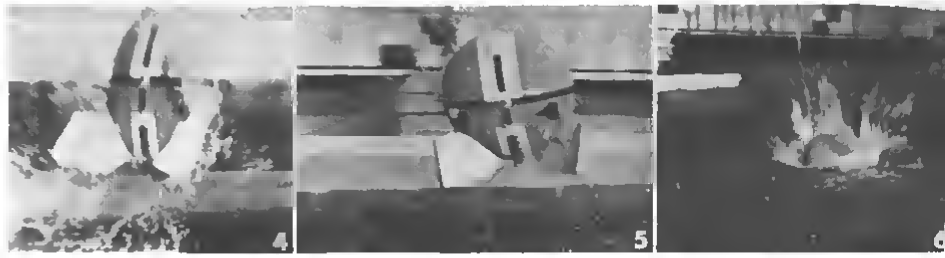
Langley's studies, which are reported in Technical Note D-975, written by Lloyd J. Fisher Jr., involve earth landing after space flight in three velocity regions: vertical velocity, landing with moderate horizontal and vertical increments, and horizontal velocity. Vertical landings were simulated using braking rockets, gas-filled bags, frangible metal tubes, aluminum honeycomb and balsa wood to attenuate shock. In the tests, a parachute letdown was employed.

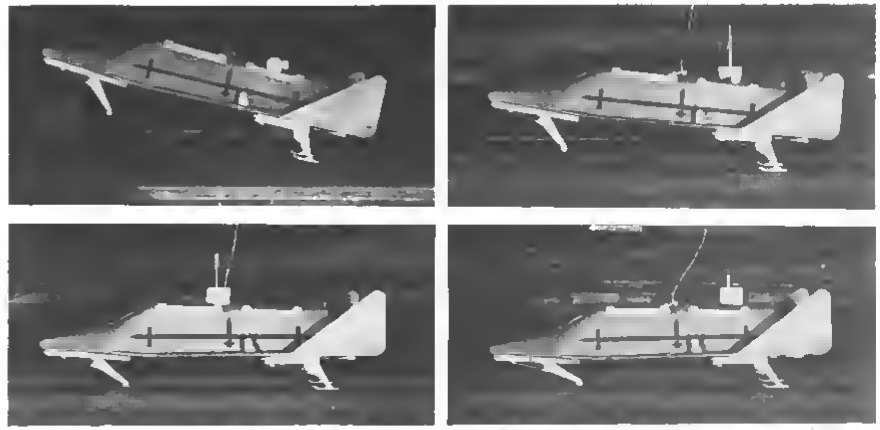
The braking rocket was found to be most suitable at high speeds and high g loading. The other dissipators are considered adequate with g loads of no more than 10, and landing velocities of 20-40 fps. In addition

(Continued on page 53)



Water landings with lenticular shapes frequently resulted in two and three contacts and complete loss of control. Reduction of landing speed reduced the tendency of re-entry vehicle models to skip. Langley studies were reported in Technical Note D-975.





Good directional stability was obtained in impact tests of a winged re-entry vehicle using steam strap shock absorbers in the all-skid landing gear. This sequence shows a model landing at 185 fps.

to landing velocities, Langley looked at the systems from the standpoints of weight, structural strength, adaptability to attachment, packaging and environment.

Investigation of the frangible tube concept involved construction of four legs made of a hard aluminum alloy 2024-T3. They were installed between the main spheroidal model and what would be the heat shield. In the tests, the tubes pressed over the die and failed in fragments. About 75% of the tube length fragmented in the Langley experiments.

Addition of a horizontal velocity increment, which would occur if wind affects parachute descent and when a paraglider is used to control landing, was tested with skid shapes frangible tubes and gas bags. Skid shapes studied were those of heat shields and included flat bottoms, spheroidal and curved structures. Shear loads on the frangible tubes and gas bags were taken up by alignment links, and the bags were angled forward.

In a test of a vehicle with a spheroidal bottom, the vertical landing energy was converted into a rocking motion which was dissipated by friction and damping. The "rocking chair" runout produces very low acceleration g's on the crew, said to be three to four.

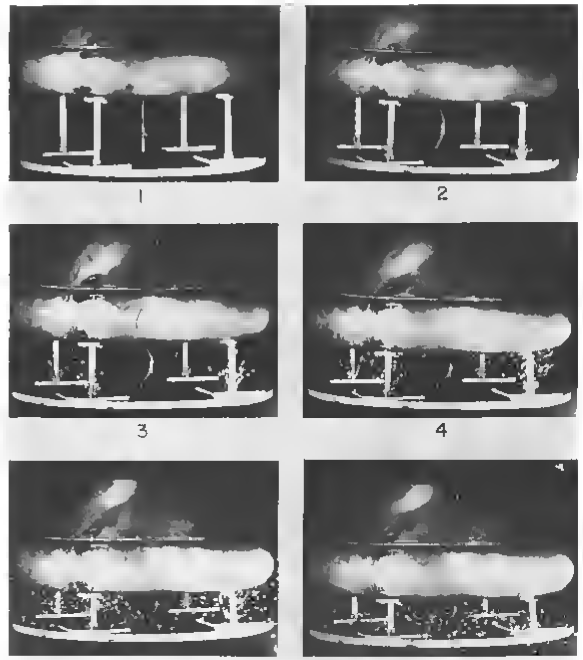
High speed landings, however, introduce a problem in stability with a tendency for the model to dump over.

In landings where the main characteristic is the horizontal velocity increment the most critical problem is behavior of the vehicle during runout.

Among the major findings in this research category are:

- All-skid landing gear on a Dyna Soar type

(Continued on page 55)

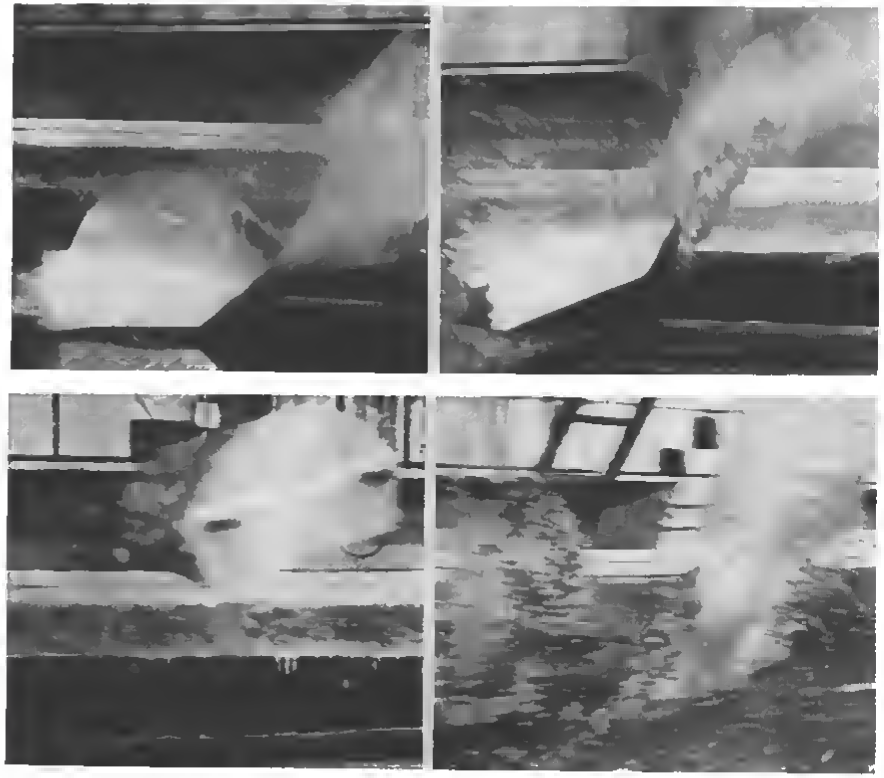


Crushing effect on aluminum frangible tube load alleviators is shown in this landing loads impact study at Langley Research Center. In this sequence, the model was dropped on concrete at vertical velocity of 30 fps. Structure beneath tubes simulates heat shield.

vehicle incorporating strain-strap shock absorbers, provides excellent directional stability even at high (185 fps.) landing speeds. No bounce resulted, and satisfactory stability was obtained for angles of roll and yaw up to 10 deg., which has been the maximum studied.

• All water landings made at high horizontal speeds except those using all-skid gear, resulted in skipping, with a high number of dump-overs. Use of drogue parachutes or braking rockets to reduce touchdown speed appreciably reduces the tendency of the models to skip.

Flat bottom manned re-entry vehicle model test at Langley's water impact basin indicates effects much the same as in model tests with curved bottoms. In this sequence, the vehicle simulates an approach at 130 fps. with a small, highly loaded paraglider.



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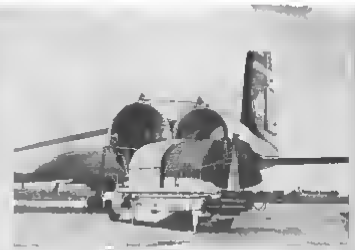
The quality and class of the Forty Four are showing up early! After only four months of service, a remarkable time-in-the-air record of over nine hours a day is being regularly achieved . . . a success never before equalled by a similar type of airplane.. and the Forty Four is quickly moving towards its optimum capability of better than fourteen hours a day. Service regularity of nearly 80% has been attained and is climbing fast.



The Canadair Forty Four is already in service with the Flying Tiger Line, the Royal Canadian Air Force and Seaboard World Airlines, and soon will be in service with Slick Airways

By every important criterion, the Canadair Forty Four, the world's first and only swing-tail airplane, has met or exceeded the original specifications offered the customer. Airline operators are enjoying substantial and valuable bonuses in terms of speed, range, fuel consumption and runway requirements.

... All this in just 4 months!

CANADAIR LIMITED, MONTREAL—A SUBSIDIARY OF GENERAL DYNAMICS

I A I.-BUILT POTEZ-FOUGA twin jet Magister trainers for the Israeli air force are on flight line for final tests before delivery. Operational numbers of the aircraft, already in their military markings, have been deleted by the Israeli censor. Magister is the first aircraft ever to be produced in Israel and is used by the air force as both a trainer and close-support fighter.

Israeli Aim Is Self-Contained Air Industry

By Ceel Brownlow

Tel Aviv—Government-owned Israel Aircraft Industries now cutting its production teeth on the licensed manufacture of the Potez-Fouga Magister twin-jet trainer, is building toward a diversified, self-contained aviation complex with capabilities ranging from airframe design to avionics development, from major overhauls to the fabrication of ground support equipment.

Headquartered in a sprawl of new administrative buildings, hangars and workshops at Tel Aviv's Lod Airport, I A I is aiming at an all-Israel airframe design as a next step in expansion and self-sufficiency and searching for additional overhaul and license contracts in a number of fields as it seeks to build its internal strength and ability for diversification.

"Our main purpose here," one official says, "is to gain a degree of self-sufficiency because we can see where Israel could be cut off from the outside [by her Arab neighbors]."

Another factor is simple necessity. At present, in support of the Israeli air force, El Al Israel Airlines and foreign contractors, France foremost among them, I A I is performing major overhauls on more than 25 different types of airframes—from gliders to Sud Vautour attack bombers—and 30 piston and jet engines—from 90-hp Continental C90s to 7,720-lb thrust Snecma Atar 101E-3s.

Besides having numerous different types of aircraft and engines to contend with, "we are so far away from everyone, we can't send back to the manufacturer every time we need something, so we have to develop our own capability," says Chief Engineer Erich Schatzki, a U S citizen who was a pre-World War 2 test pilot for Deutsche Lufthansa Airlines, an engineer at Germany's Junkers, Fokker and Heinkel and later, at the U S's Republic Aviation Corp.

I A I had hopes of establishing its own design capability with the development and manufacture of a nine-place twin-jet executive transport, the B-101C, that would have had a U S sales price of approximately $350,000 fully equipped (AW Mar. 6, p. 87; Apr. 10, p. 108).

It recently decided to back away, however, primarily because of the mounting number of similar, competitive designs being introduced in Europe, the United Kingdom and America. Another factor was the lack of expected financial, assembly and distribution aid which I A I had hoped to obtain from an established U S. firm.

Instead, the Israeli company is planning development of a Gulfstream-size turbojet transport with short takeoff and landing traits in an effort to introduce an aircraft with sufficient market potential and which also can fill a gap in the present development spectrum.

The aircraft has been studied in both two- and four-engine configurations, but the former apparently is favored, at least for the present. Projected engines reportedly are in the 7,000-lb.-thrust class. Explaining the decision to drop the B-101C after it had progressed beyond the mockup stage, an I A I executive said:

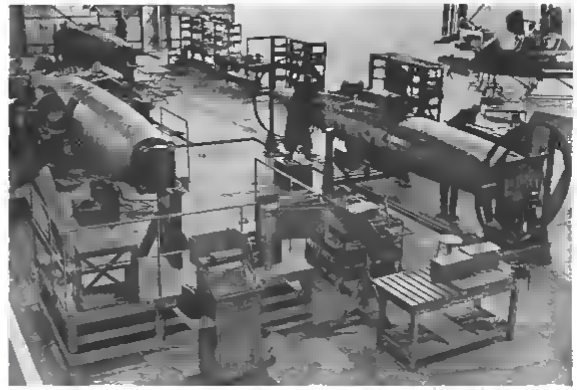
"We looked around, and everybody and his brother had suddenly come up with a small executive jet. So we decided to back off. We've redesigned and refined for better speed, endurance, shorter takeoff and landing rolls. It's a completely new aircraft from the B-101 and it looks good on paper."

No final decision has been reached, however, on proposals that the project be firmly scheduled and plans drafted for phasing into the metal-cutting stage.

I A I "definitely wants to design and build its own aircraft," Schatzki says, "and our present status permits us to build an executive jet. That's why we are primarily interested in this field at the moment."

For the future, Schatzki believes the company will move into the design of utility aircraft and light transports if the market potential seems high enough, and in doing so it undoubtedly will build with an eye on the needs of black Africa, where the Israeli government already is actively establishing firm ties, primarily in the form of technical assistance at present.

The firm also has been considering



TECHNICIANS build up the fuselage sections for three I. A. I. Magister trainers.

the idea" of designing and producing a small helicopter, but there's nothing definite on this," according to Schatzki "We are primarily interested in [fixed wing] aircraft and airframe systems" Within its workshops, however, I. A. I is gaining helicopter experience with the overhaul of Sikorsky S-55s and S-58s and the smaller Sud Alouettes for the air force

It also has modified an Alouette and several small Kolibries for use in agricultural spraying

Initial Venture

As in West Germany, the Magister marked Israel's entry into the jet aircraft production field For Israel, it also was the initial venture into the manufacture of aircraft of any type, and I. A. I., faced with the necessity of taking a major step forward as well as forming a new industry from the talents of engineers, technicians and workmen with origins emanating from around the world, attempted to make the most of it

"The French might think some of the modifications we are making on the Magister are silly," one engineer here explains "but we feel we need to do this to build up our own competence We wanted to use a certain amount of ingenuity to create a background for our capability.

"We've built our own tooling for instance, which differs from the French tooling, and we think ours is superior in many ways The French needed a higher rate of production—about 12 a month—and the size and type of tooling reflects this. We never anticipated this rate, so we changed the tooling as we saw fit, simplified and also combined it."

As opposed to the French schedule, present estimated Fouga production rate here is between two to three aircraft per month

One of the major changes in tooling was the decision to build the fuselage in a single horizontal jig rather than in the three separate vertical sections which then had to be joined as designed by the French Over-all savings four assembly jigs. All I A I-built Magister jigs also have optical tooling, while those of French design are largely manual, according to Engineer Seymour Samach, a native New Yorker

A number of changes have been made in the airframe as well Perhaps the most important deviation was the decision to substitute two starter generator units—one for each engine—to replace the single unit used on the French-built aircraft With the French unit, Samach says, "If you lost one engine, you lost your hydraulic and electrical power ... So we now have a separate generator for each engine; we've eliminated the gear box in the middle plus the drive shafts, etc., with a considerable savings in weight"

Starter Generator

The present starter generator system was designed to I. A. I. specifications by the Breeze Corp., of Union, N. J. The experience, according to Schatzki, is an example of the good cooperation the Israeli company has had with U. S. firms He says:

"Breeze built the units for us and we tested them here ... To do that over such long distances isn't easy We tested them on the bench, on the ground and in check flights and sent in a lot of requests for changes Their cooperation was very good."

From I. A. I.'s side, the design and coordination was monitored by Shalom Ostersetzer, an engineer formerly with Britain's Royal Aircraft Establishment

Four ways to tell a true airlifter

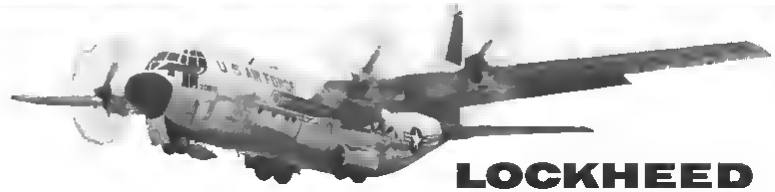
1. Straight-in rear loading

2. Truck-bed height

3. Paradrops big equipment

4. Lands on short, rough fields

A true airlifter is a special breed of bird—built without compromise for its special kind of work. Huge rear doors allow cargo to be loaded straight in. Cargo floor is truck-bed height, no hoisting cargo up and jockeying it around corners. Rear doors can be opened in flight for bulldozer-size paradrops. And a true airlifter need not be pampered with paving. It lands and takes off in sand and rough dirt, close to the action, just like a bush plane. Lockheed's C-130 Hercules propjet is the true airlifter. Now in its sixth year of operation, 14 different versions are flying or being built for the U. S. Air Force, Navy, Marines, and Coast Guard—and for the air forces of Canada, Australia, and Indonesia. Newest model, C-130E, will soon haul huge cargoes on MATS' worldwide routes. The big Lockheed/Georgia C-141 cargo jets will be true airlifters, too; they will have the same four basic attributes Hercules has.



LOCKHEED GEORGIA COMPANY

Marietta, Georgia • A Division of Lockheed Aircraft Corporation

it Hamborough Ostersetzer is one of Schatzki's two principal assistants His colleague Samuel Berke, was with Fokker before coming to Israel

The first I A I Magister came off the line almost two years ago and was turned over to the air force in July, 1960 It had been assembled here from parts supplied from France The second aircraft had been prefabricated in France but left largely unfinished By the fourth aircraft, substantially all the airframe work had been shifted to I A I

The Fouga's Turbomeca Marbore 2 powerplant and a majority of the avionic components are still built and assembled in France, however

Plastic Components

On the Israeli-built Magisters, other airframe modifications include use of a number of plastic components, an area in which I A I is considered particularly strong

These include a plastic ventral fin as a substitute for the metal French unit, a plastic tail cone and an all plastic canopy and frame combination to replace the original, more costly plexiglass and magnesium frame All of the Fouga junction boxes also are made here—and of plastic as opposed to sheet metal in the original version.

Aside from airframes, it is in electronics where I A I sees its greatest opportunity for the future, and it is erecting a rambling four-story structure to consolidate its activities and expand into original design work

The company already has an extensive instrument overhaul shop in conjunction with its aircraft maintenance programs and is building a transistorized radio compass under license It also plans to build a UHF radio under license and is manufacturing a seven piece nucleonics measuring device of its own design for export as well as sale within Israel

In another diversification effort, the company is designing and marketing airport ground support equipment, including cranes hoisting gear and baggage carts

Expanding Overhaul Work

For the present, however, I A I's strength lies primarily in its expanding overhaul work, but it needs—and is capable of—more prime and subcontract production for its assembly lines Organized in 1952, with most of its growth coming since 1955, I A I's employment now stands at approximately 3,000 persons, more than 200 of them graduate engineers, and most of the day-to-day effort for the majority lies in overhaul

There are four lines in the engine overhaul shop to handle the 30 different types of powerplants that now pass through I A I Company officials say the multitude of engine types moving over a total of four lines causes no great problems so far as the actual work is concerned, and each line has its specialists who only handle one particular type of powerplant

Powerplant Types

Of the 30, seven are turbojet and include the Hispano-Suiza Nene 104B for the Dassault Ouragan fighter bomber, the Atar for the Vautour the Hispano-Suiza Verdon for the Mystere 4A, the Rolls Royce Derwent for the Gloster Meteor and the Turbomeca Marbore 2 for the Magister The latter powerplant is still being phased into the line

In addition I A I also is overhauling the 4,120 eshp Bristol-Siddeley turboprop engines that power El Al's Bristol Britannia transports and is tooling to do the same for the Rolls-Royce Conway bypass powerplants on the Israeli carrier's Boeing 707-420s It also hopes to eventually take over the Pratt & Whitney JT3Ds for El Al's Boeing 720B transports

It is in the supply field, and the logistics flow from stockroom to shop, where I A I experiences its biggest headaches, for both the engines and the airframes

"For the 25 different types of aircraft we overhaul," Schatzki says, 'we have to use 76 different electrical plating methods . . .

"In aluminum alloys, as an example, the French, British and American are generally alike but there are differences and they can be important So, we have to get sheet metal from all three countries"

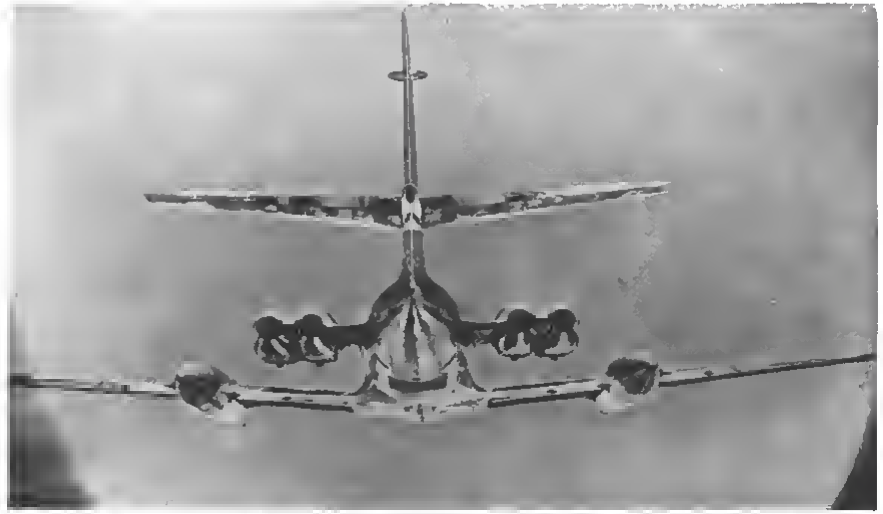
All materials are IBM-controlled, but the flow lines can still prove to be difficult

Wide Diversification

In its airframe overhaul section, I A I handles most all of the Israeli air force planes—from Cubs to Mysteres —and aircraft phasing out of the military inventory here or elsewhere, are often modified for civil use Steannan PT-17 trainers that have served their day with the air force are being converted to agricultural sprayuses, and North American P 51 fighters have been modified in the past to two-seater configurations for executive and sports flying

Its work also extends beyond the Iron Curtain, with Convair 240s of Poland's Polskie Linie Lotnicze (LOT) airline flying into Tel Aviv for the major engine overhauls

Yet, I A I is searching for more work in almost all fields "In general," Schatzki concludes, "I think we are not inclined to say 'No' when something comes up"



EXTERNAL fuel cells that encase each wing, and engine pods mounted high and aft on fuselage distinguish Lockheed's JetStar. Note horseshoe antennas near top of fin for VOR-ILS receivers. Fuel is jettisoned through nozzle at intersection of fin and stabilizer.

Aviation Week Pilot Report:

Four Engines Boost JetStar Performance

By David H. Hoffman

Marietta, Ga.—Four-engine production version Lockheed JetStar, backed by 24% more thrust than its twin-engine prototype, has gained superior takeoff and engine-out performance, yet responds like a fighter for the pilot who thinks ahead of his airplane.

Powered by aft-mounted Pratt & Whitney JT12A-6 (J60-P-5) turbojets rated at 3,000 lb. thrust, the JetStar can cruise with reasonable efficiency at Mach .78 to .82, sharing this speed regime with standard airline transports such as the Boeing 707.

Its tight landing pattern, approach speeds and maneuverability, however, correspond more closely with what the pilot expects of twin piston-engine aircraft in the Convair 440-Martin 404 class. Over-the-fence airspeed for example, is about 105 kt.

To illustrate the JetStar's stability around its vertical axis, the sudden and total loss of two engines on the same side at cruising airspeeds is compensated for by about 10 lb. of foot pressure on the opposite rudder or by about 3-5 deg. of rudder trim. Single engine failure at altitude, as simulated by this AVIATION WEEK pilot, is almost unnoticeable in the JetStar—a touch of aileron maintains directional control.

These qualities indicate the 40,921 lb. gross weight JetStar—a utility transport priced at $1,366,330 less interior and capable of carrying up to 14 passengers or from 2,787 to 4,800 lb. of payload—will present few problems to the military or corporate pilot familiar with multi-engine piston equipment.

But JetStar sales, company officials said, have been disappointing to date. Almost four years ago (AW May 5, 1958, p. 78), Lockheed held reserve delivery positions for about 58 commercial firms and estimated that orders received during the next 10 years would lead to production of about 700 aircraft. As of Dec. 15, however, JetStar orders totaled 43, of which 16 were from Air Force, 25 from various U. S. or foreign corporations and heads of state and two from the West German Air Force. In an effort to ensure a more profitable future for its over-all JetStar project, Lockheed has broadened sales efforts stressing the aircraft's merits for these uses:

- **Flying testbed for evaluating** weapon system components at relatively high airspeeds and altitudes.
- **Bomb-navigation system trainer** for Boeing B-52 and, especially, Lockheed F-104 air crews.
- **Missile site support vehicle** for hauling critical components to bases not served by commercial carriers.
- **Mission support aircraft** for ranking military officers on priority assignment.
- **Embassy liaison aircraft** for the U. S. or foreign diplomatic corps.
- **Executive transport** for larger corporations.

JetStar evaluated by AVIATION WEEK was N9205R, the seventh off Lockheed's production line here and currently the company's only demonstrator. On a flight from Andrews AFB, Md., to the Lockheed-Georgia Co. plant beside Dobbins AFB, Ga., on a round robin from Dobbins via Love Field in Dallas, Tex., and Tinker AFB, Okla., and on a local transition flight, this pilot grew familiar with the compact jet.

To summarize salient features of the JetStar, best climb speed is reached a few seconds after rotation. If V_2 is maintained, the pilot must rely solely on instruments, for all reference to either ground or horizon is obscured by the nose during an estimated climb angle of 20 deg. At typical gross weights and optimum climb airspeeds of 250 to 270 kt., the JetStar can level off at 30,000 ft. less than 8 min. after takeoff.

Stalls, prohibited above 20,000 ft., are clean in all configurations, but some

pitch up may be experienced if the aircraft is stalled with its CG near aft limits. Aerodynamic buffet precedes the full stall by 3 to 4 kt. Stickshaker warning furnished by either of two independent systems comes 8 to 12 kt before the buffet.

Extend speed brake, place thrust levers at idle, hold Mach .82 and the JetStar enters an emergency descent, a steep dive that pegs the rate of climb indicator at 6,000 fpm. Speed brake may be extended at any airspeed, but traffic pattern entry should be anticipated well in advance, for speed decay in the swept wing jet seems relatively slow.

On final approach, aircraft is aimed at a point just short of runway threshold and power is used to control airspeed. Typical angle of descent is flat as the JetStar nears its touchdown point in a nose-high attitude. Assuming proper trim, little back pressure is required to flare the aircraft and break its moderate sink rate.

JetStar's fuel, a total of 2,580 gal., is carried in six tanks: two inboard wing tanks each holding 375 gal., two outboard wing tanks each holding 350 gal., and two external auxiliary tanks, non-jettisonable, each holding 565 gal. The auxiliary tanks, which extend the aircraft's range by about 1,000 mi., were not installed on the twin-engine JetStars.

Before landing, all usable fuel must be burned from the auxiliary tanks, primarily to prevent sudden CG shifts at low airspeeds. Normal procedure, as a result, is to take off with wing tank fuel selectors in the 'tank-to-engine' position, then switch to auxiliary tanks during climb. Because auxiliary tank boost pumps produce more pressure than wing tank boost pumps, all pumps may be kept on while turbines are being fed from the auxiliary tanks. Should these tanks unobtrusively run dry, engine fuel supply will not be interrupted.

JetStar Fuel

Commercial aviation kerosene is the JetStar's normal fuel, but JP-4 or aviation gasoline are satisfactory alternates. Tank boost pumps generate the pressure for jettisoning fuel, which exits at a rate of 170 gpm. through a nozzle in the tail cone fairing.

Pre-flight walk-around inspection of the JetStar is simplified by the concentration of components in its aft equipment compartment. Entrance is through an access door opened by extending the speed brake on the ground. Hydraulic system accumulators and reservoirs, compressed nitrogen bottle for emergency thrust reverser extension, air conditioning and refrigeration packages and elevator pitch trim actuator are mounted in this area, aft of the cabin's rear pressure bulkhead.

JetStar Specifications and Performance

Dimensions	
Length	60.5 ft
Span	54.4 ft
Height	20.4 ft
Sweep	40 deg. (at quarter chord)
Cabin head room	6 ft. 1 in.
Wing loading	75.5 psf
Wing area	542.5 sq. ft.
Aspect ratio	5.27
Specifications	
Maximum gross weight	40,921 lb.
Maximum landing weight	30,000 lb.
Useful load	19,764 lb.
CG limitations	20.4 to 26.7% of MAC
Fuel capacity	2,588 gal.
Performance:	
Never exceed speed (V_{ne})	383 kt. CAS at sea level, Mach .87 above 20,900 ft.
Normal operating speed (V_{no})	350 kt. CAS at sea level, Mach .82 above 22,500 ft.
Minimum control speed (Vmc)	100 kt. CAS
Rate of climb, initial	5,600 fpm. at 40,000 lb. MGL
Service ceiling	38,000 ft.
Three-engine absolute ceiling	29,000 ft. at maximum gross
FAA takeoff field length	6,425 ft. (over 35 ft. obstacle at maximum gross)
FAA landing field length	5,485 ft. (over 35 ft. obstacle at maximum landing weight)
Takeoff distance	5,500 ft. (at maximum gross weight over 50 ft. obstacle)
Landing distance*	3,300 ft. (at maximum landing weight over 50 ft. obstacle)
Extended range mission	
Cruise speed, best economy	495 stat. mph. IAS
Approximate fuel consumption	400 gph.
Altitude in step-climb	36-40,000 ft.
Range	2,575 stat. mi. with 1,700 lb. reserve fuel
Payload	2 crew, 8 passengers plus baggage

* Without using reverse thrust

JetStar's cockpit appears equal in size to that of a Douglas DC-3, but compact instrument display, excellent visibility and functionally arranged controls give an illusion of greater roominess. Duplicate flight instruments face the pilot and copilot on the instrument panel, with engine instruments and annunciator warning lights centered between them.

Overhead switch panel contains starter-generator, air conditioning and pressurization, compressor bleed and lighting controls. Immediately forward of the throttles is a fuel management panel with tank selectors, boost pump switches and crossfeed valve controls installed at appropriate positions against a schematic diagram of the JetStar fuel system.

Mounted on top of the pedestal between the pilots are switches for extending the JetStar's speed brake and trimming out aileron and rudder forces. Mach trim compensator controls and landing lights. Aft of these are navigation and communication radio control heads.

JetStar's starting sequence boils down to pushing a button and moving a throttle. With brakes set, air start switch normal, fuel air bleed line closed, power selector switch on battery, internal fuel tank boost pump on and engine selector switch positioned to No. 3, start button is depressed. When rpm. reaches 8-10%, the throttle is advanced to idle at 23-30% rpm., the start button is released and the procedure repeated for engines 4, 2 and 1, in that order. On AVIATION WEEK's transition flight, sequence took about 5 sec. per engine.

R. S. "Skip" Schaper, test flight engineer for Lockheed, who accompanies the demonstrator on trips, rates the JetStar's ignition system the aircraft's outstanding feature. He declines to use ground power units at en route stations, and relies on the JetStar's two 24-volt, 34 ampere-hour batteries to accomplish all starts. JetStar ignition units increase

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In our world, a defense system cannot be merely adequate. We cannot risk being second best. We cannot afford to demand less than full value for every tax dollar spent.

Industry's job is to grasp the full implication of the mission, to design and build the system to meet cost requirements and delivery schedules. And to *insure* that it will perform when the buttons are pressed.

The company which can do this job has a total capability. At Hughes, this capability has many parts—a record of 15 years of scientific achievement, a working force of over 28,000, facilities covering 5.3 million square feet, vigorously applied Value Engineering and Cost Improvement programs, a fund of over 100,000 *man-years* of systems experience.

These are impressive statistics even when taken piecemeal. But they are most meaningful when seen as parts of a functional unity. For Hughes can be likened to a dynamic, *creative system* which has proved its competence and spirit of purpose many times. Examples—*The "Missile Monitor" truck-mounted mobile command and control air defense system — 16,000 airborne fire control systems — Surveyor soft lunar landing spacecraft — 33,000 Falcon air-to-air missiles.*

The broad capabilities reflected here fully equip Hughes to assume complete management responsibility for systems assembly, check-out and integration. This competence is backed by Hughes abilities in manufacturing, assembly, operator training, operational activation, field support and maintenance.

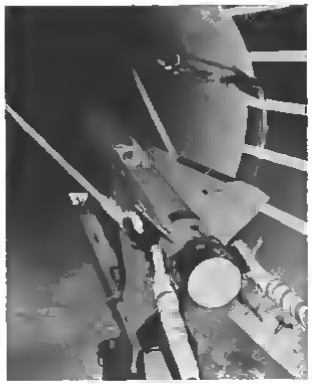
Expect more from Hughes. Hughes is ready to deliver.

Creating a new world with electronics

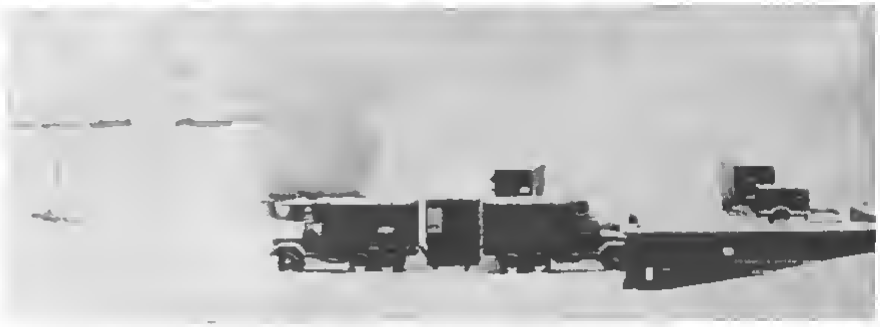
HUGHES

HUGHES AIRCRAFT COMPANY

Systems integration, as well as design and development was Hughes responsibility in the MA-1/F-106 program. Nine similar Hughes systems have preceded and followed it—a total of 16,000 airborne systems having been produced. Hughes has been the sole supplier to the U.S. Air Force of all-weather interceptor fire control systems for 12 years.

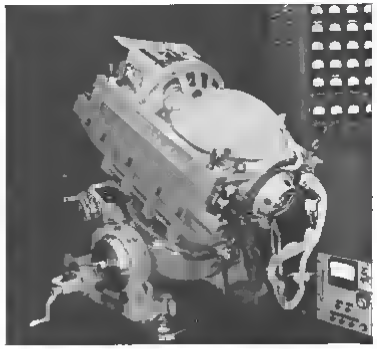


Propulsion facilities—Hughes has tested over 1,500 missiles in every conceivable mode of operation. The Hughes Tucson plant has extensive facilities for solid propellant and explosives storage and final missile assembly. The company maintains special propellant and propulsion capabilities to support procurement of solid fuel engines.



Command control experience—The Missile Monitor mobile electronic air defense system performs target acquisition and missile directing functions for Nike Ajax, Nike Hercules and Hawk batteries. At Hughes Fullerton, some 400 acres are devoted to special field test ranges for electronics systems and the Munsen course for full scale testing of instrumented vehicles under the most rugged conditions. The Environmental Laboratory has one of the nation's largest low frequency and shock facilities.

Field service and support experience—Hughes large force of experts is permanently assigned in NATO, SEATO and the free countries of the world to insure that every Hughes missile and electronics system will deliver what it should. Hughes engineers work with the U.S. Air Force on the MA-1/Falcon system, with the U.S. Navy on the Polaris, with the U.S. Army on "Missile Monitor." A Hughes team is managing the Titan site activation (photo) at Mountain Home, Idaho.



Guidance experience—A Polaris missile guidance unit undergoing check out. Other Hughes work in the area includes Polaris Submarine Fire Control Systems, special ARPAT studies, airborne tactical attack systems, inertial platforms and components, stellar tracking systems and digital computers.

battery output to 28,000 volts to gain hot spark during starting. Battery pairs cooled to −65F by Lockheed, have started up to 12 engines consecutively.

Taxiing Problems

It would be easier to taxi the JetStar if Lockheed installed either a gun-handle control or a wheel contoured to fit the human grip for the aircraft's nose wheel steering system. The pilot, as it now stands, must shape his hand like a claw to grasp the wheel and make the system respond obediently.

During taxi over level ground with all four engines idling at 42 to 46% rpm, speed tends to build excessively. To avoid riding the brakes, we reversed the two outboard engines, an acceptable procedure in the JetStar. Nose wheel may be turned 53 deg to each side of center. Wing tip turning radius of the aircraft is 44 ft, but for maintenance ground handling the nose gear strut scissors may be disconnected and this radius shortened to 28 ft.

Cleared by Dobbins tower for initial takeoff, we set the brakes and applied rated power based on engine pressure ratio (EPR) as fixed by runway temperature. Slotted trailing edge flaps were in takeoff-approach position, extended 40% of their total travel or 20 deg from the plane of the wing. Leading edge flaps, installed on the JetStar's outer wing panels, automatically went to full down 27 deg position as the trailing edge flaps were extended.

There is little need to be delicate in manipulating the JetStar's throttles. Engines will accelerate rapidly to 100% rpm with no evidence of compressor stall even if the throttles are slapped full forward. Fourth stage compressor of the JT12A engine incorporates an overboard bleed valve that virtually eliminates compressor instability. Valve opens and closes in response to pressures generated by the engines' fuel control units.

Pressure Surge

If the pilot is extremely rough with the throttles however, passengers may note some surging of the JetStar's cabin pressure. This is because a maximum of 4.6% of each engine's compressor discharge air is bled from the ninth stage compressor and used for pressurization. Since the plumbing contains no anticipator circuit, sudden throttle applications sometimes cause the JetStar's cabin to "descend" on the ground.

Takeoff EPR was 2.06, weight about 30,000 lb, CG 28.7% of MAC. With Lockheed engineering test pilot Homer V. Blalock in the right seat, we released the brakes and began our takeoff roll down Runway 28, into a 13 kt quartering wind. At about 60 kt, the JetStar's rudder became effective. Rotation speed was 114 kt and we reached it just before passing the 2,000 ft runway marker.

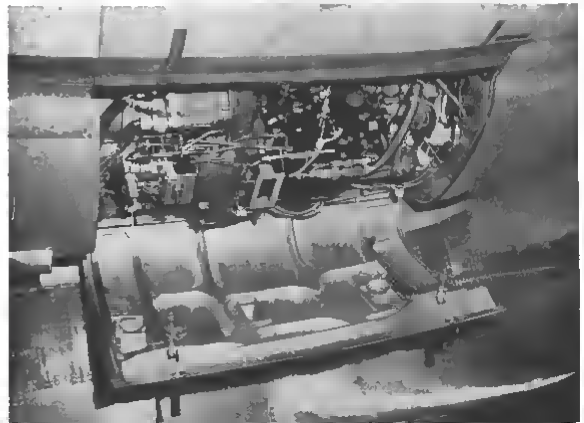
JETSTAR COCKPIT has duplicate instruments for both pilots. Note 16-readout annunciator panel right of engine instruments and drag chute release beneath radar scope

Flaps were retracted at 400 ft and maximum continuous EPR of 1.83 established. We continued our climb out at V_2, in an angle that would have stalled anything except a fighter, while Blalock kept repeating "pull it back, pull it back." Rate of climb indicator pegged at 6,000 fpm before we elected a more economic climb speed of 250 kt.

A limitation to the JetStar's certificate rules out operation above 43,000 ft. At that altitude, however, JetStar's hydraulically boosted ailerons retain their effectiveness and pilots not accustomed to a Machmeter at first tend to make their turns too tight, a practice that would impose uncomfortable gravity loads on passengers. JetStar's rate of roll according to Lockheed pilots, closely approximates that of the North American F-86.

From 26,000 ft we entered a shallow dive to check the aircraft's tuck down characteristics at the higher subsonic Mach numbers. Mach trim compensator (MTC) was turned off. At about Mach .84, aerodynamic forces began to tug the JetStar's nose down, and an

MAJOR ACCESSORIES—fuel control, starter-generator, hydraulic pump and engine oil pump—are grouped beneath engine. Access door is 5 ft from ground



ROHR clam-shell thrust reversers on the JetStar's four Pratt & Whitney JT12A turbojets open fully in less than 2 sec., reverse 45% of the engine's thrust output at rated power.

increasing amount of back pressure on the yoke was required to keep airspeed within limits.

Repeating the process with MTC engaged, we noted that this back pressure was trimmed out automatically and the JetStar, as a result, lost airspeed as it returned to level flight. MTC is effective at all airspeeds above Mach .805. JetStar may not be operated at speeds above Mach .76 when the system is inoperative.

JetStar features hydraulically boosted ailerons and elevators. Rudder is actuated by direct cable linkage, but air loads are reduced by a balance tab that moves in the opposite direction. This tab also supplies rudder trim and may be moved 9 deg. to either side of neutral by a switch on the pilot's pedestal. A toggle switch mounted nearby positions an aileron trim tab on the left aileron. For pitch trim, the JetStar's entire tail assembly is rotated up and down by buttons on the left horn of the control yoke. Emergency operation through a separate motor is controlled by a second set of switches on the pedestal.

Manual Control

Manual control of the JetStar is not difficult even if aileron and rudder boost systems fail entirely.

It is doubtful whether the loss of No. 4 engine would have been noticed had we not seen Blalock's hand move its throttle to idle. Airspeed in the relatively light JetStar at 25,000 ft. fell off about 10 kt., but no rudder was required to maintain directional control. When Blalock cut the other right-side engine, however, the JetStar yawed perceptibly, but with only about half the force of a twin piston-engine transport suffering engine failure. In standard day conditions at sea level, JetStar can climb on two engines at its maximum gross weight.

Initial engine shut-down procedure is simple: throttle off, boost pump off and trim. Engine air starts, usually prompt up to 30,000 ft., involve throttle off, engine anti-icing off, boost pump on, engine selector positioned as appropriate, air start switch depressed and held, throttle to idle. Air start switch is released at 30% rpm.

With the JetStar in clean configuration, we approached a stall at 19,500 ft. First buffet came at 123 kt. IAS and was followed by stickshaker warning at 118 kt. In approach configuration with gear and flaps extended, buffeting is more pronounced, but in neither case is there a tendency for the nose to snap. Fuel imbalance may cause the aircraft to favor one wing in the stall, but aileron control is retained and this presents no problem. However, the JetStar operating manual states:

"The rate of approach to stalls should not exceed 1 kt. per second, becoming most critical at the aft CG loadings. Exceptionally fast entry into the stall or application of additional up elevator following the initial partial pitch-out may result in loss of normal control of the airplane."

JetStar's stability at relatively low airspeed was apparent as we turned down-wind in the Dobbins AFB traffic pattern. Airspeed was 180 kt., or 20 kt. less than maximum for lowering the gear. Speed brake was retracted because its 6 in. ground clearance rules out extension during takeoffs and landings.

Throttle Adjustments

Opposite the runway's midpoint, we extended the gear, set the throttles for about 70% rpm. and dropped approach flaps. Airspeed decayed to about 160 kt. before we turned base, then fell off to 140 kt. as full flaps went down. We flew final at 125 kt. JetStar assumes these speeds—the correct ones—almost automatically in the pattern as gear and flaps are lowered. Even on final, only slight throttle adjustments are required.

Beginning a third touch-and-go, Blalock cut No. 4 engine at V_1 decision speed of 107 kt. With takeoff power and the low airspeed, hard pressure on the left rudder was needed to keep the JetStar on the runway's centerline. Acceleration nevertheless was rapid and the aircraft became airborne in about 1,000 ft. Rather than trim it immediately, we waited a few seconds for airspeed to build up. At 150 kt., we released most of the pressure on the rudder. JetStar's minimum control speed is 100 kt.

After landing the unfamiliar airplane three times in what we considered creditable fashion we asked Blalock and his fellow Lockheed test pilot, Glenn Gray, to name the prime problem encountered in checking out piston engine pilots in the JetStar. "They get overconfident," Blalock said.

Federal Aviation Agency type certification requirements dictate that the JetStar, at its maximum gross weight, may take off only from runways 6,425 ft. or longer during standard day, no wind conditions. In actual practice, however, the fully loaded airplane uses about 5,500 ft. of runway to break ground. FAA's landing field length requirement, which precludes use of thrust reversers, is 5,485 ft. Actual landing distance at maximum landing weight is about 3,300 ft.

A more typical mission profile might involve a 1,000-stat.-mi. stage length carrying average payload of about eight passengers and FAA fuel reserves. In this instance, the JetStar could clear a 35-ft. obstacle in its takeoff phase after 2,980 ft. of runway roll. FAA takeoff field length would be 3,900 ft.

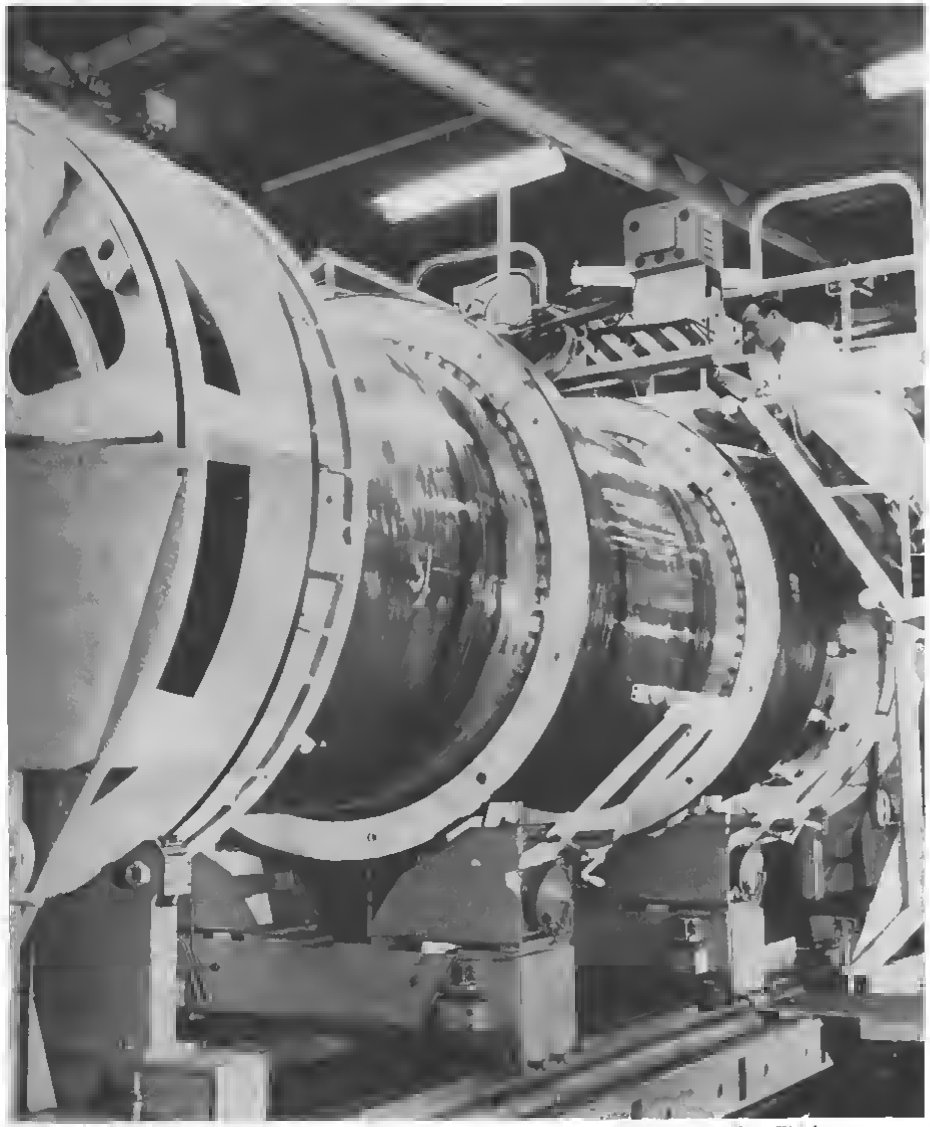
In flight, the JetStar's cabin is relatively quiet for a short, four-jet aircraft. Noise level is somewhat louder than that of a Boeing 707, somewhat quieter than that of a Lockheed Electra. Demonstrator used on AVIATION WEEK flights, however, had an austere interior with little sound-proofing. Custom interiors undoubtedly will result in even less engine and aerodynamic noise in the cabin.

Aisle to ceiling height of the aircraft's cabin is 6 ft. 1 in., but probably because of carpeting and interior lining a 6 ft. 1 in. man must duck somewhat to walk its length. JetStar's CG, located near the last seat row or just forward of the engine inlets, makes the aircraft sensitive to passenger movements. Minor pitch trim adjustment is required constantly when passengers are being carried.

Based on 600 hr. annual utilization, the cost of operating a JetStar is about $1.21 per aircraft statute mile. Lockheed reports. Over-all cost per aircraft operating hour—including insurance, crew salary and expenses, fuel and oil, engine and airframe maintenance and overhaul and depreciation—is $544.25. Of this, about $100 is for maintenance purposes, according to Lockheed.

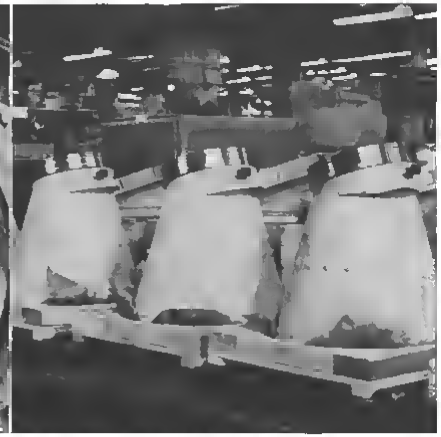
(This is the first of a two-part report on the four-engine Lockheed JetStar.)

Sophisticated Skills of Curtiss-Wright ..... Missile Manufacturing Technology



Fabrication of a flight quality first stage rocket motor case for a U. S. Air Force Minuteman missile at Wright Aeronautical Division. These huge cases are fabricated to extremely close tolerance from high strength alloy steel.

Precision machining of missile aft closure for U. S. Army Pershing missile.



Rotating rocket nozzle assembly line for U. S. Navy Polaris missile.

In Minuteman . . . Polaris . . . Pershing — versatility and depth of experience in the production of highly advanced missile and rocket components and subsystems — exemplifies Wright Aeronautical's inherent capability to support today's missile, aircraft, and electronic programs of the military services.

Wright Aeronautical has developed new technologies in forming and fabricating metals, ceramics, and reinforced plastics . . . in electron beam and protective gas welding . . . in powder metallurgy processes for producing refractory metals and compounds. It is also engaged in a continued search for new materials and methods that meet the precise requirements of current and future rocket components and subsystems.

Technological advances in rocket case manufacture include development and application of shear spinning and alloy research in titanium, 20-25 per cent nickel, beryllium and vacuum-melt alloys. Today's techniques, facilities, and sophisticated production skills furnish ultra-precision control in fabricating close tolerance rocket motor cases — high in quality . . . exceptional in reliability.

Similarly, in nozzle research, design and manufacture, new metallic and non-metallic materials and advanced developments in fabrication and liquid cooling technique, provide flexibility and imagination for future nozzle production.

Wright Aeronautical's vast experience and facilities provide a broad capability to handle programs combining management, scientific engineering and production skills in today's dynamic aerospace industry . . . and resources to meet tomorrow's challenges.

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WRIGHT AERONAUTICAL DIVISION **CURTISS-WRIGHT CORPORATION**

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FIRST de Havilland Trident jet transport is fitted with its Rolls-Royce Spey turbojets for ground runup trials at Hatfield production facility. Airplane also has performed a number of taxi tests with the three Speys operating.

Spey Turbojet Nears Airline Service Date

By Herbert J. Coleman

London—Rolls-Royce Spey turbojet engine powerplant for the de Havilland Trident three-jet transport and the BAC 111 twin-jet airliner, has drawn on extensive Avon and Conway experience in its development program.

The engine, now in the 10,000-lb.-thrust class, has accumulated more than 100 hr. of flight time in Avro Vulcan testbeds. Follow-on design, probably fitted with afterburning, is scheduled for the Blackburn Mk. 2 Buccaneer naval strike fighter.

The RB.163 Spey grew out of the RB.141 bypass engine which was designed to meet British European Airways specifications but derated to the Spey when de Havilland and BEA decided to make the Trident smaller than originally planned. Both engines have the same general arrangement and mechanical design, with the smaller RB.163 Spey backed up by considerable RB.141 test time.

Specifically, the Spey details include:

- **Two-shaft bypass engine**, with pressure ratio of almost 16:1 and bypass ratio of 1.0.
- **Four-stage axial low-pressure compressor** has compression ratio of 2.5:1 and can pass 200 lb./sec. of air. Unit is driven by two-stage low-pressure turbine, and air from this compressor is equally divided—half goes through the high-pressure compressor, combustion zone and turbines. The other half passes along the bypass duct, then is mixed with turbine exhaust gas and discharged through the tailpipe.
- **Axial high-pressure compressor** has 12 stages and is driven by the two-stage high-pressure turbine. Compression ratio is 6.5:1 and air is discharged to combustion zone at pressures up to 240 psia., with maximum temperature held to about 470C. There are 10 flame tubes in the combustion chamber.

Late in 1960, when the Spey began its initial tests, the design team could utilize data from about 1,100 hr. of RB.141 experience on nine engines.

The Spey program called for about 8,000 hr. of testbed running, and another 2,000 hr. of flight testing before the engine entered scheduled airline service. First engines for ground running in the Trident prototype were shipped last July; first flight engine was sent to de Havilland early in November, and two more followed shortly after.

Rolls has run the Spey more than 300 hr. to complete its test program on the thrust reverser and noise suppression system in a powerplant pod. Thrust reverser is similar to the type used on Rolls-Royce Avon engines in the de Havilland Comet and Sud Caravelle and on the Conway-powered Boeing 707. Main difference is in positioning of exhaust outlets.

In the Trident, the outlets have been arranged to eliminate as far as possible any ground ingestion and blowing on the tailplane, or to produce unbalanced side or vertical loads on the aircraft. High-pressure compressor air is used in the pneumatic rams which position the reverser eyelids, locks in the control system ensure that the pilot cannot inadvertently select reverse thrust. The silencing unit has six lobes to break up blast.

For better low-speed performance, Rolls designers followed Avon design in fitting the high-pressure compressor with a bleed valve at stage seven, along with variable inlet guide vanes, all progressive in operation. Bleed is controlled by a valve around the compressor casing. This air passes into the bypass duct and then into the tailpipe for added thrust. Engine speed controls guide vanes and bleed valve.

To keep internal air leaks past compressor blades to a minimum, Rolls used shrouded stator blades on the low-pressure compressor and the first three stages of the high-pressure compressor. Rotor blades and the last nine stages of the stator blades, however, are unshrouded, small tip clearances seal the stages, and these Rolls said, are determined by transient conditions. (Transient conditions are changing conditions, in that under extreme cold, the blades heat up before the casing and blade expansion could close to a critical point and strike the casing. Adjustment is made for various conditions—such as extremely hot ambient air operations. This is basically a designer's problem and Rolls aims at finding the best median setting.)

Control of blade tip clearances is by design of rigid bearing housings which, engineers explained, remain concentric with the casings under all running regimes. Split compressor casings are symmetrical and are designed so they have no local mechanical loads which could possibly cause distortion. Unshrouded internal skin protects the casings against sudden changes in air temperature; skin is formed partly by stator inner platforms, and partly by segments around the rotors.

Low-pressure compressor drum and high-pressure shaft are rigid, thus preventing gyroscopic loads which could alter the running clearances. The high-pressure compressor follows Rolls practice of construction with separate disks located on a large diameter shaft by interference fit splines, a small hairpin isolates location serrations from disk bore stress. (The hairpin is a device to reduce bore stress, thus keeping the stress from being transmitted into the disks themselves. Location serrations are the shaft cuts in which the disks are imbedded.)

Avon and Conway design has been used in the Spey in the system of fitting the pin-fixed rotor blades on the low-pressure compressor and first four stages of the high-pressure compressor. Rolls says this type of pin-fixing improves aerodynamic damping. In addition, natural frequencies of the blade can be adjusted to suit the engine's operating conditions. Low-pressure compressor rotor blades are forged of aluminum. Initial four stages of the high-pressure compressor have aluminum blades and latter stages have titanium blades. All turbine and compressor disks are manufactured from forged vacuum-melted ferritic stainless steel.

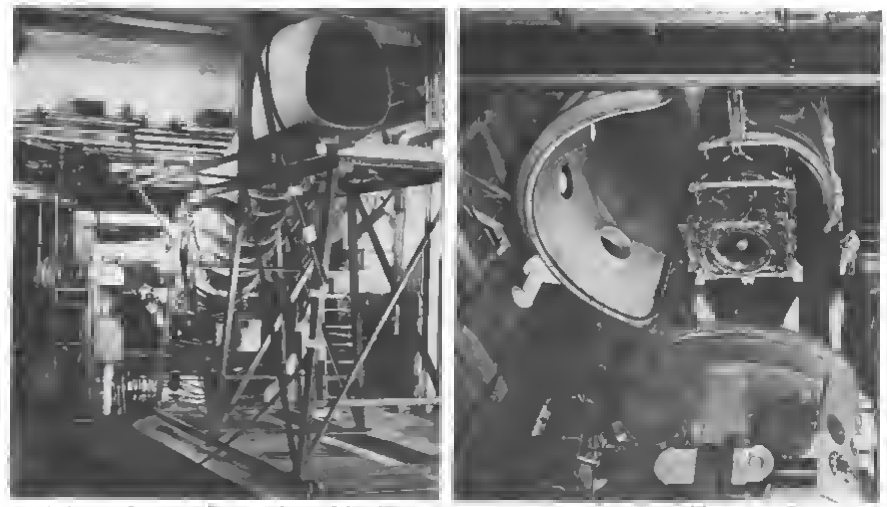
Trident will not depend on auxiliary cabin blowers for anti-icing and cabin pressurization, since all delivery air will be bled from the Spey.

Nozzle guide vanes and first stage

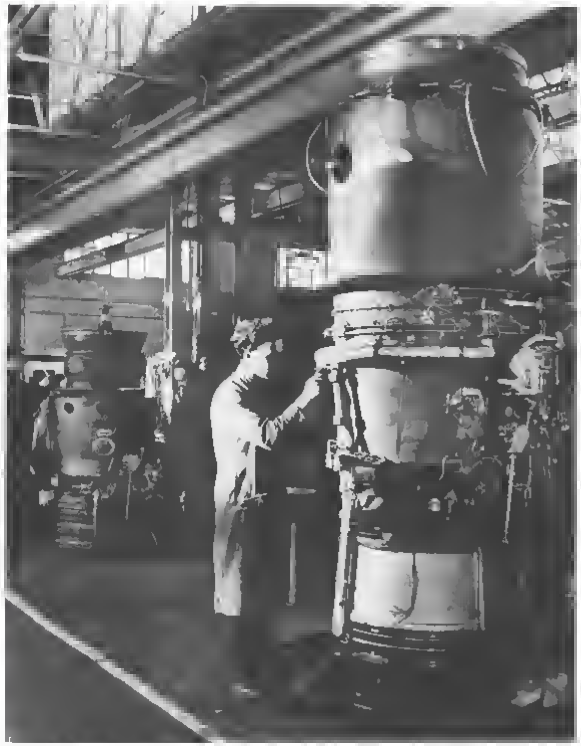
Spey Specifications

Over all length	110 in.
Maximum width	45 in.
Dry weight	2,200 lb.
Takeoff thrust (minimum)	9,850 lb.
Cruise thrust (typical)	3,700 lb.
Specific fuel consumption (cruise, 470 kt.)	0.776 lb./lb./lb.

TWO SPEYS are being flight tested on Vulcan V-bomber fitted on inner pods. Outer engines are two Rolls-Royce Conways.



TRIDENT'S center Spey engine is connected to an S-shaped intake, shown at left under test by Rolls technicians. Intake is installed at tailplane base. Rolls-Royce high altitude test facility is being used to test Spey engines at varied flight regimes (right). Facility can simulate conditions at heights above 70,000 ft. and speed of Mach 2.5.



SPEY BYPASS JET is assembled at Rolls Royce Derby plant (above). More powerful version is earmarked for Blackburn Buccaneer naval strike fighter. Strain-gaged Spey undergoes endurance tests at Rolls laboratory (below)

rotor blades of the high pressure turbine are air cooled, although the guide vanes and blades of the low pressure turbine are uncooled. Blades and vanes are made of nickel based alloys, similar to those Rolls has used on the Conway, Avon, Dart and Tyne powerplants.

All turbine blades are mounted in the disks by fir tree roots. Disks are cooled by high pressure compressor air to prevent hot turbine gas from passing over them. Leakage of hot gas across outer shrouds is controlled by fin seals. Nozzle box structure also is protected from similar leakage by segmented shroud rings.

Design of combustion system also reflects widespread use of past experience with Rolls turbojets. Flame tubes, for instance, are much like those used in the Conway, now up to an overhaul life of 2,200 hr. and PA 29 Avons up to 3,200 hr. Fuel injection is standard Rolls design, consisting of swirl atomizer burner to give good fuel distribution under restart conditions at altitude.

Spey utilizes both ball and roller bearings, with thrust loads on main shaft ball bearings adjusted by varying the seal diameters until small axial gas load of known direction is obtained. Main shaft bearing chambers are cooled by air from low pressure compressor, and then discharged overboard. Airflow leaks from high-pressure to low-pressure zones are limited by non-rubbing rotating seals, all of which are lined with a low melting point material to prevent overheating in case of a rub.

All main shaft bearings are lubricated by oil jets, each has its individual filter. Central oil tube is inside the main shaft system and low pressure unit cooling air insulates it from hot exhaust system. Central oil tube runs full length of the engine to lubricate all main shaft bearings with exception of the turbine bearings, which have separate feeds.

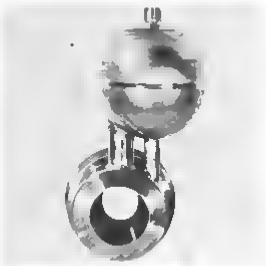
Scavenge oil is returned to a tank, tray and air from the de-aerating tray is vented to the wheelcase. This, in turn, has centrifugal breather to separate oil from air. Rolls claims that on the basis of past experience, this system should guarantee engine oil consumption of less than 0.75 pints/hr., which is the guaranteed limit. The tank has a 12 pint capacity, of which 10 pints are usable oil.

Spey is mounted in a Rolls-designed pod, hung from two cantilevers on the Trident's structure; these are braced together by the fixed part of the cowling. Spey pod for the BAC 111 is similar in design.

Engine itself is fitted to the front cantilever through a ball joint at the side and a radially swinging link at the top. Rear cantilever is attached to the top of the Spey by a pair of axially swinging links. Design fatigue life is about 30,000 hr. of operational flying.

How Solar's experience with refractory components creates space-age structures

Current weapon systems require structural components that can withstand extreme temperatures. With solid fuel rocket engines operating at over 6000F and re-entry vehicle components experiencing equilibrium temperatures of 2000 to 5000F, materials systems are being taxed to their limits. Significant advances in high temperature structural technology are required to meet these demands.



Experimental lithium-cooled rocket nozzle

Solar has called on 35 years of experience in high temperature materials and structures to meet these problems. This experience has created an integrated, dynamic organization with materials research and development, structural analysis, prototype and production manufacturing capabilities.

Solar's work in rocket nozzle technology includes development of tungsten forming and joining techniques. Shear forming and hot die forming techniques are available for producing the complex shapes required for nozzle components. Joining tungsten by solid state bonding and reactive brazing has been accomplished, resulting in unrecrystallized joints with usable strength in excess of 4000F. A current program at Solar is aimed at design and fabrication of cooled nozzles for extreme temperature operation. Other research projects include compatibility of liquid metals and exhaust gas products with refractory metals, and a unique method of thrust vector control.

Re-entry vehicles require refractory components over a major portion of their outer surfaces. Solar is working on a contract to develop, fabricate and test frontal sections for a super-orbital glide re-entry vehicle. Temperatures in excess of 5000F will be experienced during re-entry for this component, representative of the next generation of glide re-entry vehicles.

Solar's current capabilities in fabrication activities supply a broad base of supporting technology for refractory component assembly.

Plasma spraying techniques are available for the deposition of any of the refractory metals, as well as the ceramic materials which are difficult to fabricate by any other process. Recent projects at Solar have included the fabrication of parts from tungsten, 90Ta-10W, columbium, and molybdenum alloys.

Spinning of centrifugally cast rings for rocket nozzle

For further information about Solar's refractory component experience in materials research, design, fabrication, and testing, write Dept. J-156, Solar, San Diego 12, California.

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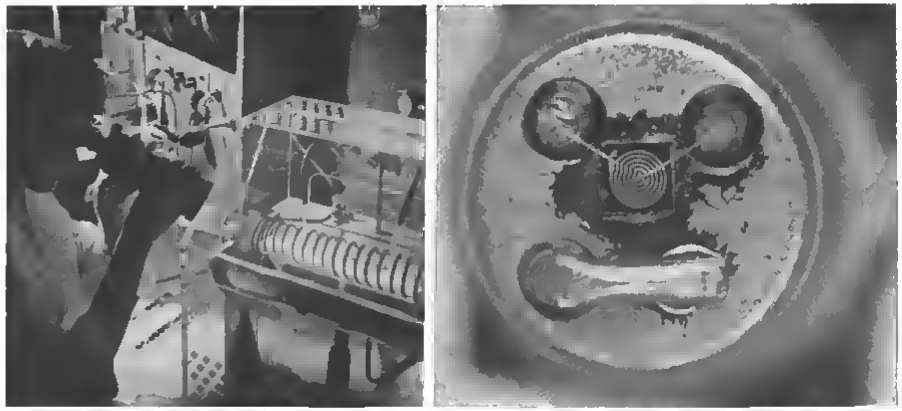


BROAD INTEGRATED CIRCUITS research and development program under way at Motorola, Inc., Phoenix, is attempting to find compatible processes among several solid state technologies so single devices selectively using any number of these processes ultimately can be made on same production line. At left, semiconductors are epitaxially grown On TO-18 header (right) is metal film inductor built up on 25-mil square semiconductor substrate. Partly supported by USAF's Aeronautical Systems Division, the inter-divisional program attempts to mate equipment-oriented interests of company's Military Electronics Division and device viewpoint of its Semiconductor Products Division The program involves between 40 and 50 engineers, mostly in Motorola's Semiconductor Division.

Motorola Investigates Compatible Circuits

By Barry Miller

Phoenix, Ariz.—Comprehensive Air Force-funded program in integrated circuits, aimed at developing compatible semiconductor and non-semiconductor thin film techniques so that more reliable, less expensive avionic devices may emerge from a wedding of the two is getting under way here at Motorola, Inc

Three-year Air Force research and development program (AW Jan 23, 1961, p 97, July 10, 1961, p 75) also is attempting to mate or reconcile the diverse interests of equipment and device engineers during the early stages of integrated device development

Functions Incorporated

This is necessary because many of what were normal functions associated with circuit design using discrete avionic components—functions such as circuit organization, design and interconnection of parts—now are incorporated by the manufacturer with the integrated circuits (Integrated circuits are single semiconductor substrates in which one or more devices are an integral part Th integrated circuit may be a portion of or a complete circuit function)

Motorola is trying to unify these devices and equipment viewpoints within its own organization by bringing together in the Air Force program engineers from its device-oriented Semiconductor Products Division and equipment-oriented Solid State Electronics Department, which serves as a research arm of the company's Military Electronics Division

Potential Value

Potential value of compatible techniques appears to be two fold Compatible processing would enable a single multi-step production line to selectively turn out integrated circuits using a mix of techniques—diffusion, epitaxial growth, thin passive films, etc Any circuit might be fabricated by a preselected combination of up to 30 anticipated steps in this line As a consequence, it also would make possible the fabrication of integrated circuit devices combining the optimum properties of devices that are made by each process

For example, resistors may be more easily realized with thin non-semiconductor films evaporated on top of an integrated circuit than by using resistors obtained from diffusion in the basic semiconductor Some materials and techniques are better than others in different respects and will yield larger, or different or broader ranges of values and better isolation. Some function better at high frequencies, others at low, some have better temperature coefficients

Motorola hopes to develop fabricating processes conducted at temperatures and other conditions that will not disturb the product of a previous step in its projected production line Hence, devices might be fabricated, probably on a semiconductor substrate, in or on which are semiconductor diffusions, growths of epitaxial layers, semiconductor passive components, thin passive components, insulating layers and metallic conductors

Program Supervision

Involving roughly 40 to 50 engineers, mostly in the company's Semiconductor Division, the interdivisional Air Force program here is under the overall supervision of C Harry Knowles It constitutes roughly a third of Motorola's corporate investment in integrated circuit research and development

The Air Force contract will be cost shared over its three-year period and will finance nearly $2 million in research and development

This effort is one of three major ones currently sponsored by the Electronic Technology Laboratory of USAF's Aeronautical Systems Division The other two programs, which predate Motorola's, are being conducted by Westinghouse Electric Corp (AW Apr 27,

1959 p 54) and Texas Instruments (AW Nov 6 p 83)

While in a few respects the Motorola program duplicates these other efforts, particularly the Texas Instruments' work, the company brings to the program rather unusual capabilities according to an Air Force technical official in Dayton. These lie in the areas of surface passivation of semiconductors, epitaxial growth of semiconductor layers and development of small, thin film inductors.

In addition, Motorola's effort is directed primarily toward linear, rather than digital circuitry. At first glance this appears to be and ultimately could prove to be a less promising direction than the latter. Digital circuitry, specifically as it appears in aerospace guidance computers with their large numbers of repetitive circuits in which device tolerances need to be less exact than in communications gear, is an especially attractive area which has drawn attention for application of integrated circuits. A primary advantage of these solid state devices is in the cost savings resulting from the fabrication of a multitude of semiconductor active and passive components in a single circuit as they might be required for digital equipment.

Many Advantages

Nevertheless, use of integrated circuits in telemetry and communications equipment may provide many other advantages such as increased reliability, size and weight savings. Motorola's traditional corporate interest and experience in the communications field coincided, according to the company, with the Air Force's desire to explore application of integrated circuits in the RF field to supplement other R&D in the digital area.

As one of its first objectives, the company has a target of developing a cigar-shaped, ½ watt 120 mc telemetry transmitter and receiver by June. This device is in the conceptual stage.

As a possible final task in the program, the company is investigating a complete integrated circuit telemetry system transducers, signal conditioning gear as well as transmitter and receiver.

Both of these equipments Motorola emphasizes are research vehicles to demonstrate feasibility of compatible techniques rather than formal prototype equipment.

The complete telemetry system might include transducer, log generator, compressor, digitizer, encoder, commutator on the data gathering end and corresponding components in the receiving end. At present Motorola has designed the receiver RF amplifier, and is well along in the design of a ½ mc IF strip. It is investigating use of low-Q inductors with tunnel diode Q multiplier. Other components such as a demodulator, Darlington amplifier and output transducer are in varying stages of study while the mixer has not yet been designed.

While concentrating on linear circuitry, Motorola is conducting considerable activity in digital circuits. It is working on "nor" and "nand" circuits in addition to video and servo amplifiers, RF amplifiers, 12-mc and ½-mc IF amplifiers.

This dual interest in linear and digital circuitry is expressed in the company's marketing plans for its first integrated circuits.

Motorola expects to complete pilot production and circuit design facilities by the middle of next month (February) and in March market a line of tight specification, epitaxially grown integrated circuits in 10-pin TO-5 packages with both standard and pancake height caps. Circuits probably will include input and output amplifiers, flip flop, "nor" and "nand" gate, buffer and line driver amplifiers.

In the second quarter of this year, it intends to introduce the first of its compatible integrated circuits combining thin films deposited on integrated circuitry. Following these at a future date will be a line of high speed computer circuits.

Typical compatible integrated device which combines the use of thin films and semiconductors is the three transistor video amplifier pictured in two accompanying illustrations. A breadboard model of this device has a response from dc to 300 mc, 25 db gain and 35 db of feedback.

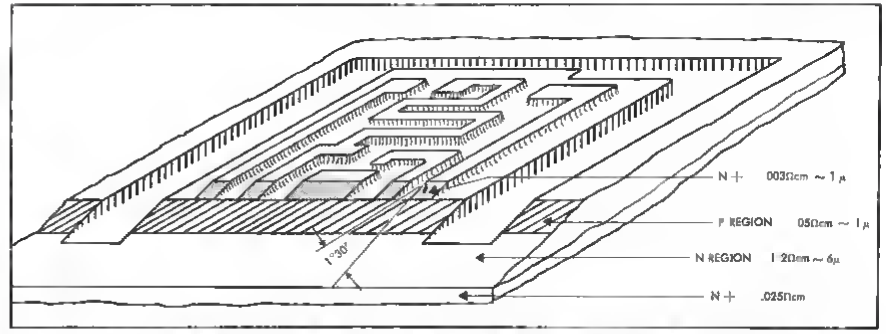
Fabrication Method

The device is fabricated from a 5 mil-thick slice of one-inch diameter P-type single crystal on which an N type semiconductor layer is epitaxially grown. The N layer would provide the collector regions for the three transistors and the collector resistors in the first two transistors.

A P type semiconductor would then be diffused through a mask into the block to form the bases of the three transistors. In a second diffusion step, an N plus region provides emitters and collector contacts. A final diffusion of P plus material, or an evaporation, forms the zener contact for the two coupling diodes.

After passivating the surface of the entire device, the remaining resistors are evaporated in two layers (two depositions are needed to obtain the desired topography). Contacts are made by etching into the block.

These extrinsic resistors are tin oxide films with which Motorola's Solid State Electronics Department has had extensive experience. The device's surface is passivated after each deposition. Con-



EXPERIMENTAL "NOR" circuit made by epitaxial growth of semiconductor layers to demonstrate capability of process consists of mesa transistor, three parallel equal value input base resistors, and a smaller value collector resistor. Circuit is fabricated by successive growth of N region (collector) P region (base) and low resistivity N region from which emitter and resistors are selectively etched.

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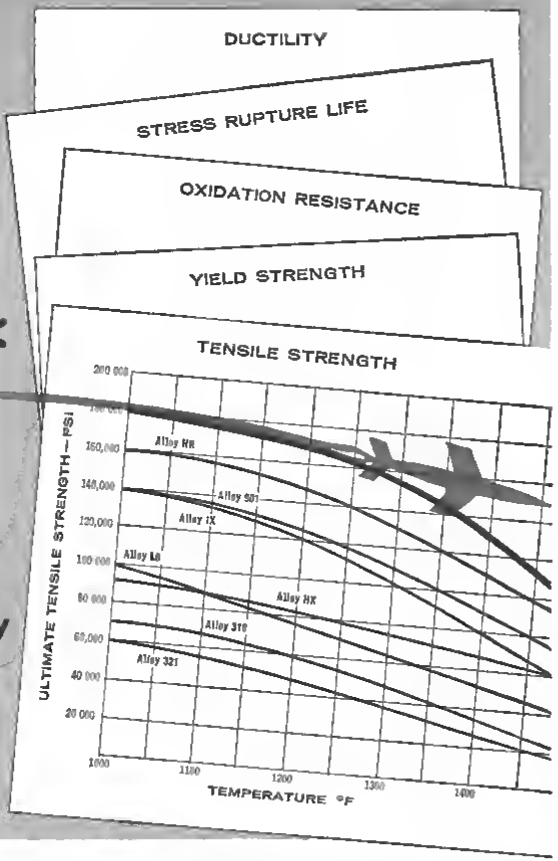

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*Left—hydrogen peroxide valve; right—jet engine flow divider; foreground—accelerating valve.

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ductors are evaporated and etched.

Flow chart for this amplifier, Knowles points out, is roughly equivalent to that of a high-quality planar transistor with the addition of the two resistor layers.

One of Motorola's tasks in the Air Force program is to define the relative advantages of different types of components in the compatible structure. In designing and fabricating compatible, integrated device, the designer has freedom in selecting a number of types of resistors, for example. They can be made from metal and metal oxide films, bulk resistivity of the semiconductor, diffused resistor, diffused resistivity and epitaxially grown layers. Many factors including stability, compatibility, cost, topography of the desired circuit, ease of fabrication, range of values and type of circuit desired enter into selection. In digital circuits, where values of resistors may not be too critical, diffused resistors may prove satisfactory. High resistance values would exclude bulk resistance. The precise limits on these factors are being studied in the program.

Capacitor Selection

Similar factors influence capacitor selection. Capacitors formed in a semiconductor substrate by back-biased junctions are suitable for non-critical coupling capacitors, possibly voltage variable capacitors, thin anodized metal film capacitors are useful where exact, voltage stable capacitors in values below a microfarad are needed, deposited metal oxide glass capacitors may be desired for high voltage, non-polar, low capacitance units.

A few of the research and development areas in support of the integrated circuit effort include:

• **Epitaxial growth**—As a demonstration of the readiness of epitaxially prepared (growing a single crystal layer on a substrate whose structure is almost identical to the film being grown) materials, the Semiconductor Products Division's materials department, headed by Dr. Remo A. Pellin, has made epitaxially grown "nor" circuits like those pictured in an accompanying drawing (p. 87).

Thus "nor" circuit has three inputs to the mesa transistor base, each with a 6,500 ohm resistor and a fourth resistor (750 ohms) in the collector circuit. The circuit is fabricated by three successive growths on an N-plus (25 milliohm-centimeter resistivity) substrate. In the first growth, a 6-micron layer of 1 to 2 ohm-centimeter material is grown to provide a collector region. Above this is grown a one micron 50-ohm-centimeter region, which forms the base. Final growth is a three-ohm centimeter, one micron thick N-plus layer from which the transistor's emitter and four resistors are etched. The structure may be welded to a header with the collector lead thrust through it. The emitter is etched away to bare the base and bond a lead to the base.

Resistivity can be controlled to ±10% on the one to 10 ohm-centimeter material, according to Pellin. Thickness of the micron thick layer can be controlled to 10%.

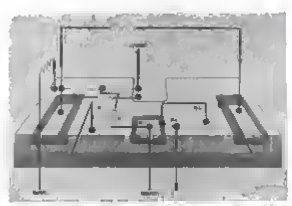
Motorola has complete facilities for epitaxial growth of silicon and germanium and is preparing a gallium arsenide facility. Varactor diodes have been fabricated by growing gallium arsenide on germanium.

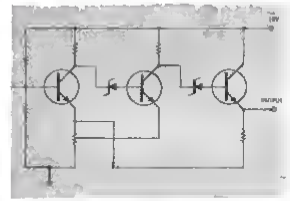
Epitaxial Growth Process

In the epitaxial growth process pure hydrogen sweeps over a heated substrate and removes impurities from the surfaces on which semiconductor films are grown in the furnace. Silicon or germanium tetrachloride vapor, depending on which semiconductor material is desired, is then led into the system. The vapor is reduced on a substrate surface and films are grown to controlled resistivity.

The epitaxial technique, the company points out, allows greater freedom in selection of impurity layers than does diffusion. The latter has an inherent limitation in that the impurity content of each layer must be higher than the others.

• **Thin film inductors**—Realizing larger valued inductors and transformers in microminiature has been a problem since microelectronics began. Where as in RF circuitry, coils are necessary, they generally dwarf other components. Partly supported by a $50,000 Navy Bureau of Weapons contract, the Solid State Electronics Department has been making single flat spiral coils on Fotoceram or alumina substrates in inductance values to two microhenries. Occupying about ¼ in. square, the 2 microhenry coils at 10 mc. have Qs as high as 25. In processing the coils, mil thick copper is deposited on a substrate, etched away to form desired spiral pattern, and the spiral replated to get a thicker coil (keeps resistance down, thereby boosting the Q of the coil).





VIDEO AMPLIFIER being investigated illustrates possible combination of semiconductor and thin passive film techniques. Compatible integrated circuit (left) corresponds to three-transistor video amplifier (right). Entire circuit is fabricated in series of sequential steps—including epitaxial growth of N layer on a P crystal slice, three masked diffusions, passivation of surface, evaporation of two layers of thin film resistors followed by final surface passivation. In effect, processing is equivalent to steps in preparation of high quality planar mesa transistors with addition of thin film evaporations. Circuit, in breadboard stage, has gain of 25 db, response from d.c. to 500 mc.

Under the Navy program, Motorola is combining the use of flat spiral coils with ferrite bulk material using the ferrite as a substrate and as a core to raise inductance and Q. The ferrite might be suitable as a substrate for other circuit elements as well.

Motorola also is examining thick film ferrites deposited by pyrolysis of metallic organic esters. With proper masking, it may be possible to make thin film solenoids encircling these ferrites.

Navy activity is focused at 1 mc. and inductance values between 30 microhenries and a millihenry and Qs of 100 or greater. To achieve these parameters, the department will attempt to make finer lines and increase the number of turns in the coil, thereby boosting inductance.

Coil Suitability

As part of its Air Force program, the company will investigate suitability of making coils as well as LC combinations on semiconductor substrates. Inactive substrates, such as alumina, steatite (magnesium silicate) also will be investigated.

• **Surface passivation**—Essential to an effective integrated circuit program is the need for reducing or eliminating chemical changes at the surface of a semiconductor device, changes that could alter a device's electrical characteristics. This is particularly important in integrated circuits where numerous operations are performed on a single structure. Motorola, through the activities of a group headed by Dr. Steward S. Flaschen, has developed a method for passifying surfaces with an inorganic material, a modified silicon oxide (glass) coating built up at 500C.

The passivation method consists of accelerated oxidation of the surface of a

semiconductor (silicon or germanium) to form glassy SiO_2 or GeO_2 at lower temperatures than previously necessary. Flaschen says his group hopes to further reduce the temperature of passivation (perhaps to 350C for germanium). Acceleration is made possible by modifying and distorting the network structure of the silicon or germanium dioxide glass with inorganic impurities. Knowles says accelerated glass coatings make possible passivated diodes with reliability exceeding that of hermetically sealed devices.

Zener Diodes

Motorola is introducing a line of surface passivated zener diodes, thereby becoming another in a small group of companies which have product lines of devices which rely on surface passivation alone rather than hermetic encapsulation. The zener diodes Flaschen explains have been tested successfully to hermetic seal specifications subjected to the usual high temperature and high humidity cycling with the additional restraint of having power applied to them during the tests.

The company claims to have boiled water by passing current through passivated diodes without changing the diode's reverse current at 100C. Under reverse bias aging at 200 v. and 150C for 1,000 hr., passivated diodes have shown good stability of reverse currents.

■ **Thin film passive components**—For several years, what is now the Solid State Electronics Department has had an extensive effort under J. Black in thin film passive components (in addition to the recent work with inductors). Its current efforts revolve about two types of resistors—tin oxide and nichrome. Tin oxide films are made in values from 100 to 20,000 ohms/sq. held to ± 10% tolerance and produced in 50% yields by hydrolysis. Temperature coefficients (for 1 to 5 kilohms) are 1,000 ppm/deg C negative. Nichrome resistors range in value from 50 to 300 ohms/sq., ± 5%. Temperature coefficients for these are greater than 100 ppm/deg C positive.

Other Resistor Types

Other types of resistors such as indium oxide films, produced by a relatively low temperature technique which might be invaluable in integrated circuit cases where higher temperature resistance fabrication could damage other temperature sensitive elements in the integrated circuit, are under study by this group.

Typical of capacitors fabricated are tantalum films, obtained in 6 volt-microfarad/sq. cm. values (1% dissipation factor) and silicon oxide in 0.1 volt-microfarad/sq. cm. values (± 20%). The latter are good to 50 mc. or 100 mc.

■ **Semiconductors on insulating substrates**—Under the Air Force program both the Semiconductor Division and the Solid State Electronics Department are investigating the deposition of thin film single-crystal semiconductors on foreign (non-semiconductor) substrates whose crystal structure is nearly identical to that of the semiconductor. If suitable substrates are found, thin film semiconductors on foreign substrates could add a greater degree of flexibility to the choice of substrates for integrated circuits. They might provide better electrical properties for deposited passive films than would a semiconductor substrate. They would lower the minimum capacitance that can be obtained for coupling, cut mutual influence among components on a substrate and enable resistors of more precise values to be evaporated. Efficient dissipation of heat might be difficult with insulating substrates, however. Solid solutions of Groups 1 and 2 salts and refractory oxide solid solutions are among the substrates Motorola is believed to be examining.

■ **Packaging**—Variety of methods of packaging compatible integrated circuits including the use of multiple lead headers corresponding in size to those of conventional transistor types in some cases using pancake style cans, in others, almost conversely employing a multiple decked arrangement above the header. The latter might permit stacking one type of integrated circuit atop the other. Thus arrangement might accommodate a mix of circuits on different substrates: some integrated circuits in semiconductors or substrates, others on ferrite or insulating base, yet all are housed on an accepted size header inside a single tall can.

Estimated packing density for the multi-decked package is 10⁷ parts/cu. ft. Motorola also is examining rectangular packages, but the final choice of optimum formats and packages probably will be governed largely by individual

MULTIPLE WAFER structure mounted on multiple-lead TO 5 header is one of a number of packaging schemes being considered by Motorola in its compatible integrated circuitry program

customer requirements and evolution of the integrated circuit market. A 10-pin TO-5 package with a pancake top is regarded as a minimum package until suitable passivated packages are made available.

• **Active device technology**—Active Device Group which prepares integrated circuits from semiconductor crystals prepared for them by the Materials Group is headed by Arnold Lesk. This group's activities encompass a diverse number of activities that includes fabricating integrated circuits, evaluating their electrical characteristics, building processing equipment and preparing a pilot engineering line.

To ensure that the reliability levels now being attained with individual semiconductor components can be carried over into integrated circuits activity, Motorola is attempting to employ the same processes.

The question of reliability of integrated circuits poses somewhat of a paradox. On the one hand, integrated circuits should be more reliable than a circuit composed of individual components for a number of reasons—a paramount one being the smaller number of leads and interconnections. They should also be cheaper because of higher possible yields.

Yet the absence of reliability data, in any way comparable to that which is available for high reliability transistors and diodes accounts at least in part for the reluctance, thus far, of any major systems manufacturer to specify them for a major weapon or space system. The newness of this field and the absence of any sizable orders, has precluded extended life tests of the type which are becoming commonplace with individual components.

USAF Emphasis

Air Force in this program, Motorola says, is emphasizing monitoring and control of processes in a manner akin to that followed in the apparently successful high reliability component program conducted by Autonetics for the Minuteman ICBM guidance and control systems.

Motorola's introduction of integrated circuits brings to about one dozen the number of companies now offering such devices for sale. A few of these organizations privately will concede that the market for integrated circuits is still premature, some will admit it is virtually non-existent today.

Yet each company apparently believes that the competition for tomorrow's integrated circuit market will largely be won or lost now. Each company is desirous of influencing the type of circuit organization and the nature of packaging upon which the industry eventually will settle. More important perhaps, by entering the market now with devices still primarily in development, each company announces its intention of competing in this field. They can now vie for the interests of aerospace systems manufacturers with whom the integrated circuit manufacturer must work closely. It is no secret that major weapon system manufacturers under the impact of the accelerated pace at which integrated circuit research and development is progressing are exploring possible switchover in current weapon and space systems to integrated circuits. Motorola admits to having discussed their use with responsible organizations for Mariner and Apollo spacecraft boosters and Polaris missiles.

Autonetics, associate prime contractor for the Minuteman ICBM, currently is evaluating proposals for their possible use in the inertial guidance system of the growth version of Minuteman. Motorola and Pacific Semiconductors (AW Nov. 20, p. 19) are two of the companies which have submitted proposals.

Should Minuteman or another major weapon system adopt integrated circuits now, the entire marketing picture would blossom overnight.

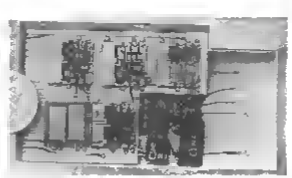
The use of integrated circuits will require close liaison between maker and user, far closer perhaps than ever existed with other new devices even transistors. Motorola expects that this liaison will involve about four distinct steps leading up to fabrication of particular circuits for a customer. The steps would be:

• **Breadboarding**—Customer would breadboard types of circuits he wants with standard components.

• **Compatible breadboarding**—Customer would then breadboard his circuit with parts made by compatible techniques.

• **Chip circuits**—Circuit now would be synthesized using individual chips or substrates with components identical to those which would finally be used.

• **Integrated circuit**—Circuit would finally be realized on or within a single substrate as an integrated circuit.



STAIRSTEP GENERATOR, which provides output of 64 discrete voltage steps, illustrates ability to fabricate devices using a mix of thin film passive components and conventional discrete components separately. Shown in photo are five ceramic substrates with film capacitors and resistors and uncased transistors and diodes (substrate at lower left contains two capacitors only). At lower right are precision resistors and Zener diode.

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*As proposed in the recent Project Beacon Report of the Task Force on Air Traffic Control.

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New Incentive Contract Plan Advanced

Department of Defense intends to broaden its use of incentive type contracts and has been critical of industry for its failure to provide specific contract formulas that would reward above average performance and penalize poor performance (AW Nov. 20, p. 26)

In light of this feeling, a proposal for such a system advanced by Dr. Simon Ramo, vice president of Thompson Ramo Wooldridge at the American Rocket Society Space Flight Report to the Nation takes on added interest. Major excerpts from this speech and subsequent elaboration follow—Ed

No one doubts that we are engaged in a massive transition to a new highly technological society. Everyone close to government-sponsored projects knows that research and development of the new has now taken over as a more dominant factor than production of the old. Look at the growing percentage of the government budget for technological projects, no matter how these projects may be labeled or categorized, and it is clear that the complex, the new, and the speculative are replacing the familiar and the well defined. The output is characterized by a small quantity of more expensive, "big-step-forward" apparatus, obsolcted often before it can be made in reasonable quantity, its design depending on the latest discoveries in science, even before that scientific background is well understood, and all of this in an environment in which the strategy for the utilization of technology to achieve practical goals, and the goals themselves fluctuate rapidly.

Yet today we are still trying to operate with a government-industry pattern based on concepts and detailed rules that were invented for an entirely different combination of circumstances, for a world in which the government was purchasing not development effort but rather the production of clearly specified items to be manufactured and to be delivered on carefully prescribed, firm schedules.

Because we do not have an industry-government relationship suited to the new technology, project we can see about us some negative consequences. The new technology industry is tremendously unstable. Engineers and executives move about rapidly from company to company as programs fluctuate. It is overexpanded in many respects. Some organizations are in deep valleys down from recent peaks, while others are completely overloaded. Competition is great, but largely to receive the award of a task. The incentive for maximum return on investment is tied not nearly so much to performance in carrying out a major developmental project as it is to the skill shown in winning the privilege of carrying it out.

In an age of severe technological obsolescence, in which the big project controls the little one and in which all of the big projects are interconnected, government chairmanship becomes all the more essential and only the government has a broad enough view to plan ahead well. Yet industry must plan ahead in an effort to eliminate the inevitable hiatus between projects. Lead times being what they are in the entire process, it is common that as a major project reaches its crisis of activity, and before all of the problems are solved, it is necessary to commence preparation for the acquisition of another one, for a superb performance on a difficult development job is no real assurance of the award of a new one as needed for stability.

In space and in other advanced technology, we are now admittedly in a race. We cannot afford to have very many of our most creative technologists engaged in panicky promotion. We cannot afford to have rules of operation which fail to take advantage of the inherent potential in privately financed industry. Competition and incentives should be working for us, not against us.

Analogy Cited

Let us start by looking at this matter of competitions by way of proposals for the award of an important development project, the competitions for the enviable backlog, the assured role for a number of years in an important program. Let us describe an analogy, which is admittedly an exaggeration, but which allows us to make an unexaggerated major point quickly.

Many of us have youngsters who registered for geometry this fall. It is their hope and ours at least that they work hard, learn geometry, and get a good grade. This will help to assure their future. Suppose that we find, however, if we look in on the first three days of the course that classtime is taken up not with geometry but with a rather curious procedure. We find each of the children in the class giving a three-minute oral presentation, telling why he should receive an A in geometry. This is accompanied by the submission of a two-page proposal, written by the student, telling how smart he is, how smart his parents have been before him, how many hours he intends to spend a week studying geometry, and what unrequired side texts he promises to read. One of the proposals mentions that the student has two uncles who are whizzes at mathematics, and one quotes from a signed letter from a neighbor who studied calculus, indicating that he is willing to contribute at least an hour a week of additional tutoring. Sometimes two or three children submit a joint proposal in which they indicate that they will help each other, one team member is said to be good at proving theorems, another is very neat. As a package they propose to accept one A and two Bs.

Of course, the parents telephone the teacher during these proposal days, and probably in fact during a good part of the summer.

Finally, at the end of these three days, the teacher decides on two students who will receive As, seven Bs, twenty-two Cs, six Ds, and four flunks. Four of the students will not get a passing grade, no matter how hard they work during the course that is about to begin. They will have to take geometry over. But the boys with the As have it made. Of course, if they insult the teacher or do horribly poor work, they may get thrown out of school, and they will certainly have their grades lowered somewhat. We observe, however, from the record of the past several years that the teacher works very hard to help the A student. There is a bit of a commitment that was made at the beginning of the course.

Some claim that this system is a good one because it makes for competition amongst the students and provides them with incentive. And indeed it does—for that three-minute speech, the two-page report, and the family politicking all summer. Once geometry starts, once the substantive part of the school year is under way, competition and incentives are relatively trivial factors.

Others point out that basically there is protection in this system, because next year there is trigonometry. During the three-day proposal period that opens that course, the trigonometry teacher will remember that some of the students who rated As and Bs in geometry did not come up to expectation. Their proposals for trigonometry will now be taken with a grain of salt—that is, if we are talking about the same high school and if the trigonometry teacher is the same one who previously taught geometry, or if the trigonometry teacher really studies the geometry teacher's

records, and in fact if there is a good enough system to maintain records so as to correlate proposals with performance as a means of judging the next proposal.

Now, this is a fictitious high school. Bad as the true grading system may be in judging a student's true performance and potential, I am glad that the real high schools use their present grading system rather than the fictitious proposal system just outlined.

Current System

But what system do we use to award major jobs today? I think this can be answered by citing a question put recently by an important member of the government concerned with such problems. He said, "How can we get the smartest people out of the proposal business and back to doing a job?" The answer is obtained by putting together two things. The question itself and the fundamentals of the free-enterprise system.

The answer is, don't make the proposal so important in providing the return on investment. Don't assign the profit on proposals, but rather on performance. Tie both the award of new work and the reward for work accomplished to quality of performance, then you will find the energy concentrated there.

Let us try now to picture a new system that does just this. In this new system, each major government activity sponsoring developmental work would have associated with it, reporting to its central head, a special operation which I shall loosely call the Performance Rating Group. This is not to be an ad hoc panel set up for each project. It will be a substantial corps of individuals who become expert professionals in the matter of providing useful performance ratings. They will serve not only during the awarding of projects, but also in the rewards applied as the work progresses. This group will use every source—the independent government project heads who are directing the program, the industrial contractors on that project, and others in and out of government. The Performance Rating Group will be involved in the program from its inception to completion, carefully interviewing and obtaining facts, judgments and ideas from every conceivable source.

It will set up initial rating factors that will hinge on the nature of the developmental project for which a contractor or a group of contractors is being sought. Thus, some projects may be distinguished by requiring good performers in certain fields of technology, as well as an ability to make practical selection out of numerous potential approaches. Some tasks will require choosing a contractor with a good record for invention, others may involve a more routine, efficient testing operation to determine the best of several approaches already recognized. Some jobs will require organizations capable of spanning a variety of fields. Some will be characterized by the importance of working closely with the military, let us say, on the relationship between technology and requirements. Others may be carried out with a more detached operation. Some projects will involve urgency, where speed of attack is more important than absolute control of the minutia of expenditures. Other jobs may have a great emphasis on accomplishing an acceptable performance within a small dollar value.

In short, an attempt will be made to diagnose the job in such a way as to make possible the examination of performance records of candidates in an effort to obtain a match between this performance capability and the project's requirements.

Next, imagine that the system has been in process for a number of years. A justifiable and large effort has been made to provide an outstanding performance rating system. On a typical job that has taken several years and a hundred million dollars, a dozen categories of performance and numerous check points and rating points in time for each of these factors have been recorded.

Rating Averages

Now, the result of this is, amongst other things, that one foundation ingredient of the plan now becomes possible—namely, all contractors doing business with the government can in time establish rating averages or what might be called rating signatures. Thus, a good contractor might have a 7 or 8 rating, while a poor contractor might have a 3 or 4 rating, or even a zero rating. This rating can serve to provide the center point of profit expectancy when a job starts, and might also influence the additional fee up or down which the contractor might expect to earn doing the job. Therefore, a contractor whose performance rating is good knows, upon receipt of a job, that he has coming a 7% fee which might perhaps go up to as high as 14%, though it could also go down below 7, if his performance during the course of the work so warrants, while a contractor with a rating of, say, 3 might be able to work his fee up to as high as 6% or 7% and no higher, or it may again drop down to zero.

During the competitions for award of a new program, an analysis of the nature of the job and a study of the detailed record of performance of contractors will constitute two of the main government efforts prior to calling in the candidates.

In most of the larger developmental projects, the specific technical ideas proposed, now so frequently allowed to play a major part in the judging, and sometimes allowed virtually to dominate them, will in the new system be reduced to a rather minor influence. So will the cost estimates. After all, even those contractors with large, active programs and correspondingly large allowed bidding expense, and who in addition perhaps may put into the proposal operation rather unusually large amounts of their own money, still end up spending less than 1% of the man hours on the proposal that will be required of the total job. Thus, for a hundred million dollar program lasting several years, a major contractor will rarely reach such a figure as $1 million total invested effort prior to contract. If this 1% sample is used as a major consideration in awarding the work, it is like giving the geometry grade for a semester of one hundred classes based on the work done during the first day's class. This is especially objectionable when it is realized that of the leading contractors, the very best one from the standpoint of doing the other 99% may be much too busy on active projects soon to finish to give that 1% best effort at this point. Furthermore, it has become typically true that the criteria for judging this 1% as to worth of technical ideas or funding estimates are not available and will not be until a much greater fraction of the work is done.

So, during the competition phase, the contractor with an established high listing by the Performance Rating Group, based on its detailed records of performance, is at a great advantage. In winning a competition for difficult, advanced development work, performance should count much more than promises.

It is clear at the outset that no revolution can or should be attempted in contracting procedures. The problem is too complex. Acceptance by industry and Congress could not be immediate, even if a plan were proposed that is far superior to the present mode of operation.

Nevertheless, certain actions could and should be taken right away.

Study Needed

One kind of action is to begin seriously to study the problem. Another is to make some small starts where it already appears to be safe to do so because the benefits would appear to greatly offset any risk.

Under the first item—that of studying the problem seriously—one or two full-time assistants for this purpose should be brought into each agency which puts out research and development contracts. Ideally, these should be experienced people who are knowledgeable in the fields of performing

research and development within the present government machinery and who are expert in the workings of that machinery Their job would be to try to assess the various ways of implementing a true performance-rating system or some other improved system

It is probably possible to start experimenting with a rating system A number of existing research and developing contracts, some large and some small could be selected for this

Another specific action that could be taken at once is the designating of a new and publicized category of R & D projects with some immediate changes in the procedures for contracting for this category The category would be for those projects that are considered extremely speculative, i.e, where the following kinds of questions are especially tough to answer

- **Can technology really offer a solution to the particular requirement?**
- **If so, by what technical techniques?**
- **When might it be expected that an answer will be reached?**
- **How much might it cost?**

Thus, for this category the Department of Defense announces that the job will be assigned not by the conventional proposal competition but by a capability competition alone in which the contractor's proven past ability to handle jobs that are believed to be somewhat like this and the resources that he now has available will be the key factors This makes sense, of course, only if the government announces that it has decided that it can afford to assign to this job for the next year a certain amount of money, this money to be spent in exploring the area by a contractor who is believed to be best suited Any contractor who comes in with a proposal to do this exploration at less than this price as a sales gimmick would be declared out of order

A final recommendation for immediate implementation is to choose certain contracts and, with the concurrence, of course, of the contractor who is carrying out the contract already, or who is about to be awarded a contract not yet begun implement a new kind of incentive fee system

As an example, the contract might be awarded on a minimum base of, say a fee over costs Or, if the job is already in process, it would be continued on a 4% fee in place of the usual 6%-7% or 8% fee However, it is understood by the contractor (who becomes a willing guinea pig for the experiment at some financial risk) that an extraordinary effort will be made by the government to assess his performance and that, based on the quality of performance, he will be awarded an additional fee This could perhaps be up to 12%- Thus, the contractor can finish with between 4% and 12%

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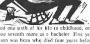

A man passed one sixth of his life in childhood, one twelfth in youth and one seventh more as a bachelor. Five years after his marriage, a son was born who died four years before his father at half his father's final age. What was the man's final age?

—Contributed

How are you on juggling gyros? On rotating resolvers? Innovating integrators? We're talking to you engineers with experience in inertial systems. If you've a background that includes an acquaintanceship with sub-miniature electro-mechanical devices, transistorized circuitry and/or computing techniques, talk to Don Krause at our Guidance and Control Systems Division. The interview should be mutually interesting.

ANSWER TO LAST WEEK'S PROBLEM: Determine the height of the equilateral triangle to be 3 inches. The sum of the diameters of the circles at each vertex is 1 inch, and the sum of the diameters of all circles is 5 inches. Since $\Sigma \pi d_i = \pi \Sigma d_i$, the sum of the circumferences is 5π inches.

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Misplaced Laurels?

This is my first "Letter to the Editor" of Aviation Week magazine in over six years of subscription (and I have just subscribed for another three years). I regret that I must request withholding of my name in that I am still on active military duty (19½ years total, 17 years active). The reason for writing is one of your "Laurels for 1961" (AW Dec. 25, p. 9).

I cannot agree with your 16th Laurel (the one for Jackie Cochran). So what? I am not aware of details of the flight but I would not be surprised that an instructor pilot accompanied her (like so many publicity stunts). No trick when an IP is aboard. Even if she flew the Talon solo—I still say "So what?"

Your magazine is much too valuable to provide space for something of no consequence, especially when another event is of consequence for 1961. I wish to nominate a genuine "Laurel" to replace your 16th Laurel of Dec. 25. I refer to Project Highspeed. Your coverage of Highspeed when combined with your coverage on the 1963 fiscal budget provide a milestone along our path to national survival. I refer specifically to the air defense against manned bomber problem. This weakness is succinctly reported in your editorial of Aug. 7 ("Defensive Problems"). I pray and I hope that what has been started by Air Defense Command and the Aeronautical Systems Division will reach maturity however I fear that politics—vested interests—invisible pressures—will sidetrack this vital issue. The problem is the myriad influences which stupid, selfish and shortsighted people create. The facts when ugly and scandalous are buried or forgotten. The F4H is an impressive aircraft—in the hands of the U. S. Navy. If the USAF buys the F4H, and I hope it does, why must it wait until Fiscal 1963? If the USAF buys the F4H is it going to make a eunuch out of this sterling and impressive reliable weapon by starting its many unfathomable modifications? I am not bitter, not in the least! I am just frightened. In the hands of naval pilots and radar observers the F4H is deadly and potent. It must remain so. In comparison to other aircraft the reliability of the F4H is a dream—a pure joy. Could it be so simple that its simplicity is the key to its potency; could it be that the radar observer contributes mightily to its all weather intercept capability? It is time that we get rid of the complicated electronic nightmares! Throw out the publicity and advertising snares, destroy these snares and their nefarious schemes. Things like design deficiencies, for instance—trapped fuel—instability—faithful inadvertent releases of every imaginable external store when combined with electronic and blackbox guaranteed unreliability are the facts in this matter. We are paying heavily in money and health in time for our delusion, however well-intentioned.

In one final word on this issue I indict another culprit, i.e., the penchant and obsession of those who produce volumes and volumes of words, rules, supplements, regulations ad infinitum. This is ably illustrated in AW of Oct. 2 which describes FAA beginning a program of simplifications (that magic word again) for FAA safety rules, viz., boiling down 6,000 or 7,000 pages of regulations into one document containing about 60 simplified (there it is again) rules. The FAA stands not alone with this sickness. It is perpetrated and perpetuated in every dimension and in its inundation strangles, stifles, destroys men and ideas. It overwhelms the honest man, the hard worker, the good "attitude," the loyal military man, in addition it creates despair and drives away the patriot. It undermines our security, it places in the gravest peril our national survival.

So you see Mr. Hotz, any one of the two above described events merit status as a Laurel for 1961. From one in the ranks, these words come. There are some key people who should hear these words, not spoken emotionally. In addition, I must add that I am a taxpayer. I have maintained a good 19½ years of duty to my country (two tours of combat—World War 2 and Korea). I have never written to my congressman. I will fight again if necessary. I am fighting now. In the words of my favorite early American, Benjamin Franklin: "There never was a good knife made of bad steel."

Major
United States Air Force

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Nike Zeus Funding

Eleven months ago I breathed a sigh of relief because I felt we were shedding the dangerous Eisenhower Administration philosophy that balanced budgets are some kind of guarantee of national stability and security. Like millions of other Kennedy supporters, I expected the new Administration to own up to the enormous military threats facing this country and move boldly and realistically to meet them.

Now the Secretary of Defense has disapproved $140 million in pre-production funds for the Nike Zeus anti-ICBM missile (AW Dec. 25, p. 14) which were recommended by the Army and some DOD officials for the Fiscal 1963 defense budget. Your article surmises that Mr. McNamara took this action to help the Kennedy Administration offer a balanced budget, hoping that Congress would later authorize the Nike Zeus funds. This, naturally, would enable the Administration to claim that Congress, not the Executive Branch, is spending all those "extra" millions.

So here we go again—playing political football with a weapon system that is vital to our very survival in a thermonuclear war. At this time the Nike Zeus is our only solid hope as a defense system to guard our prime military bases, industrial centers, transportation nerve centers and cities against sudden and complete destruction in a surprise Soviet attack. We have built our strategic forces into a powerful retaliatory arm, yet we are taking a chance of losing the defense which would enable these forces to survive a surprise attack and ultimately destroy the Communists' ability to conduct a global thermonuclear war.

What are Mr. McNamara and other Administration leaders hoping that their latest exercise in duplicity will achieve? That removing the Nike Zeus funds will make it possible for the budget to obtain congressional approval? If so, then their very hope that Congress will add the money later seems to refute that premise.

I am convinced that most Americans would gladly accept the allocation of $140 million, or fifty times that amount, for Nike Zeus development. If we don't provide the urgently needed funds to obtain an effective anti-ICBM defense, we may very well relinquish our freedom, in fact our lives, for the sake of maintaining a neatly balanced national ledger. Let us spend whatever is necessary to build Nike Zeus and to develop the even more refined systems which will eventually replace it in our missile defenses. I can only hope that the next three years of the Kennedy Administration will not see the Chief Executive and his top assistants constantly placing the nation in jeopardy in a mere attempt to make its people believe that security is a cheap commodity.

Name Withheld by Request

Too Many Cooks

I read with interest the Nov. 27 article on p. 30 regarding Senator Jackson's statement resulting from the two-year study of the Senate Subcommittee on National Policy Machinery. I think that it is indeed refreshing to find a report that openly recognizes and specifically points to areas that are inefficient because of too many people. Although there are many jokes about "Parkinson's Law," it is interesting that this book presents in considerable, though humorous, detail the mechanisms by which areas become staffed to the point of inefficiency.

In brief, the parallel between Senator Jackson's report and the "theory" presented in Parkinson's Law is most remarkable. I would suggest that not only all government agencies but all organizations of any size make "Parkinson's Law" required reading as there is food for serious thought in this little book.

It appears that the management problems faced not only by the various bureaus of our Federal Departments but also by our private industry, as the organizations become larger and more complex are indeed serious ones and can, if not watched closely, result in situations such as Senator Jackson's studies have shown.

Jack E. Willer
Reynoldsburg, Ohio

Why this ESNA floating anchor cap seal nut will soon be probing outer space

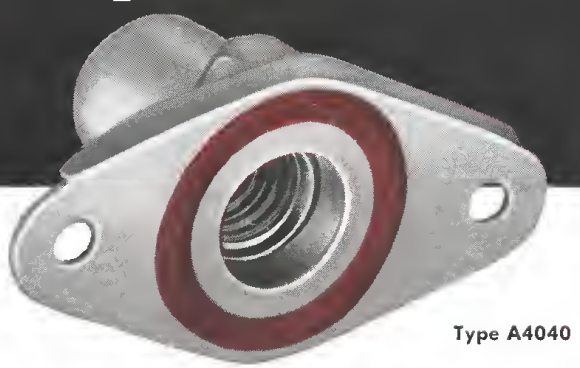
This Type A4040 floating anchor, base seal, capped nut has been selected to go along on the first manned space flights aboard the National Aeronautics & Space Administration's Astronaut capsule. We can't illustrate this special application as yet, but we can tell you about the unusual performance characteristics of this new design.

Type A4040 is a self-locking anchor nut with a special "0"-ring in the base that provides an hermetic seal to prevent loss of air pressure through seepage along the bolt threads. The stop nut held captive inside the dome provides .020 inch minimum radial floating action to allow quick bolt installation in spite of slight misalignment of bolt holes. It is *100% seal tested* before shipment. The seal is effective whether the bolt is installed or not, and is not destroyed by repeated bolt installations. It will withstand vibration and temperature variations from –70° F. to 400° F.

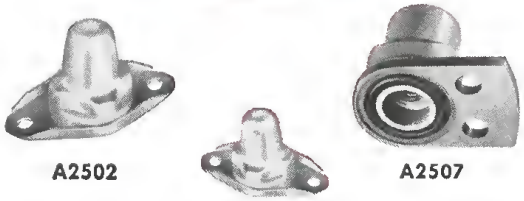
The A4040 is a typical example of ESNA's willingness to work on the special fastener problems faced by engineers who are designing for the space age.

Let us send you complete details on the wide variety of cap seal nuts specifically designed for internal fuel tank fastenings to prevent seepage of volatile fuels: two lug (A2502) and its miniaturized equivalent A2506; one lug (A2507) and straight gang channel strips (G2500). Consider too, the access door design opportunities provided by a football-shaped ring of cap seal nuts such as the one illustrated above and which is performing outstandingly in the integral fuel tanks of one of the nation's newest jet liners.

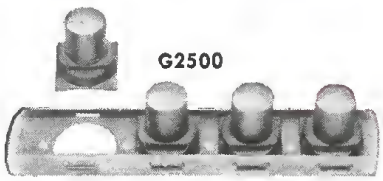
Write . . . Dept. S54-225, Elastic Stop Nut Corporation, 2330 Vauxhall Road, Union, New Jersey.



Type A4040



A2502 Miniature A2506 A2507



G2500

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